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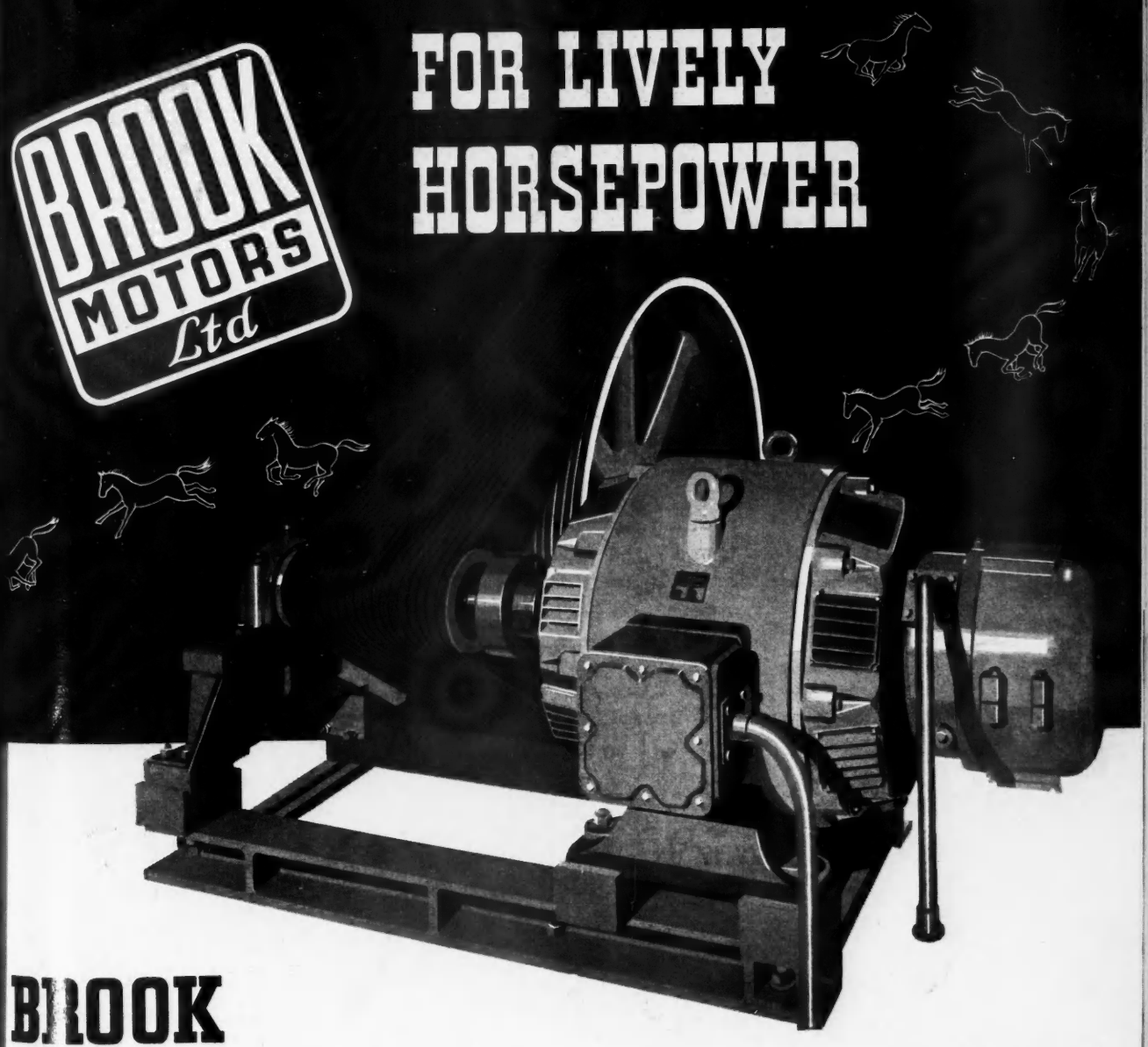

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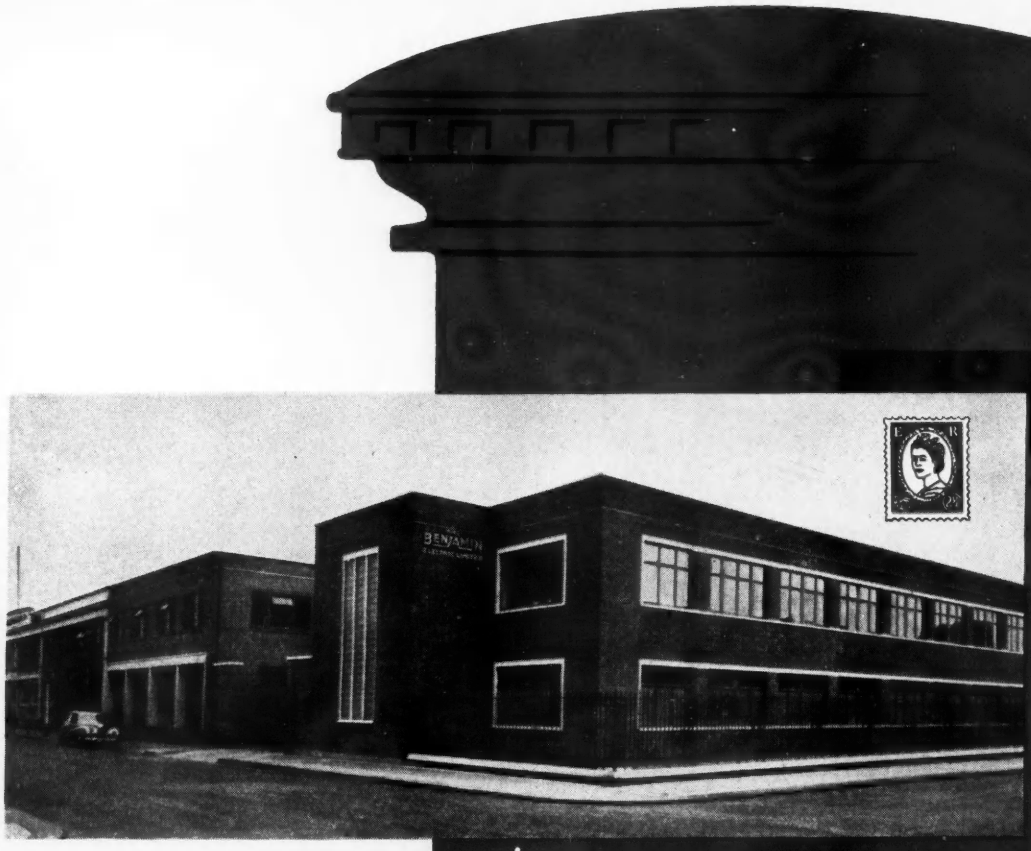

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

20 JULY 1956

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Engineers and Nuclear Generation

SOME part of the difficulties inevitably presented to the electrical power engineer in the understanding of the essentials of nuclear fission appears to have been extended to the straight engineering aspects of the generation of electricity by the conversion of nuclear energy. We do not for one moment suggest that the physics of nuclear energy is not the concern of the electrical power engineer—quite the contrary—but we feel that undue emphasis on one aspect only will create a distortion of perspective. This might lead those not fully informed, at home and abroad, to suppose British manufacturers to be engaged in working out new and highly specialised methods to meet entirely novel requirements, whereas what they are doing (and have already done) is to employ their wide experience and immense resources in producing components for nuclear stations that are either the same as or not far removed from their normal standards.

Indeed it seems unlikely that the next two or three decades will pose technical problems more difficult than those surmounted during the evolution of coal-fired stations from the era of the reciprocating engine to that of the modern large turbine. One cannot doubt that there will be commensurate progress, though in a shorter time, with the use of nuclear fuel, provided this development is based on the broadest engineering foundations.

Rejection of the idea that the utilisation of nuclear energy can be regarded in isolation is manifest in the work now in hand for building and equipping atomic power stations by groups of manufacturers whose normal activities taken together cover virtually the whole field of engineering. What has already been done in this way was exemplified in a paper on Calder Hall power station which was presented at the recent World Power Conference (see *Electrical Review*, 29th June), the authors of which represented the several collaborating companies and the Atomic Energy Authority.

It is intended that collaboration at this level shall be strengthened by arrangements between major professional institutions as the reservoir of technological knowledge, rather than by setting up a new *ad hoc* body, the disadvantage of doing which was referred to by Sir Christopher Hinton on the inauguration of the British Nuclear Energy Conference last November. A final co-operating factor will be found in the long-established engineering journals which can be relied upon to give a correct perspective in recording and commenting on specific advances against a background of technical information that is derived from a large variety of sources and takes full account of factors found essential to efficient operation. The position was aptly summed up by the authors

of the paper just referred to who, in agreement with Sir Christopher Hinton, showed that substantial parts of the engineering work at Calder Hall are very closely related to the normal products of their designers and constructors so that the central design team of the Atomic Energy Authority has been able to draw on suitable experience. That consideration will apply, we believe, with even greater force in the case of the future nuclear stations included in the programme of the Central Electricity Authority.

FIRST C.E.A. NUCLEAR POWER STATION

Elsewhere in this issue reference is made to the consent given by the Minister of Fuel and Power to the establishment of what will be the first public supply nuclear power station in this country. We are well aware, of course, that the Calder Hall nuclear energy station will be supplying electricity to the grid very soon, if indeed it has not already done so, but the new station, namely that at Bradwell in Essex, will be the first power station for operation by nuclear energy to be built under the Central Electricity Authority's nuclear power programme which was announced last year.

From one viewpoint we think that the most significant part of the announcement of consent is that "The detailed design and construction of the station are open to competitive tender and the proposals of the four industrial groups of manufacturers who are entering this new field are due in October." In saying this we do not for one moment belittle in any way the work which has been done already by the nuclear energy scientists and engineers to bring about the present stage of nuclear energy development. What we really have in mind is that the Bradwell station will represent the first occasion when nuclear energy engineering proposals will be put forward on a competitive basis and this, as has always been the case in the engineering and industrial fields, will give the movement a new impetus, both commercially and technically.

HIGH-VOLTAGE TRANSMISSION

An interesting account of developments in high-voltage transmission in Sweden is given by Mr. Åke Rusck, head of the Swedish State Power Board, in a booklet recently issued by the Board. Dealing with the 380 kV a.c. network, which was first energised in 1952 and will consist of 1,900 miles of line in 1958, and the 100 kV d.c. submarine line to the island of Gotland put into operation in 1954, Mr. Rusck discusses how far Sweden is likely to go in the field of high-voltage transmission.

If present knowledge had been available when the 380 kV system was planned a higher voltage, probably 450 kV, would have been chosen. The insulation level of the 380 kV lines will allow an increase to 500 kV when internal excess voltages have been reduced. The matter is now being thoroughly studied and the possibility is not excluded that the voltage of the system will be raised to the 450-500 kV level, at least in some parts. Investigations are also proceeding with a new and much higher voltage system and it has been found that 650 kV is probably the limit. A 650 kV a.c. line of four bundled conductors will have a transmission capacity of about 2,000 MW and two or three such lines would be sufficient for all power transmission in Sweden in the future. Work is also being done on a 400 kV d.c. transmission system and the prospects seem favourable. The type of line being studied would have a transmission capacity equal to that of the 650 kV a.c. line.

CONVENTION SUGGESTION

The variety of interests represented at the British Electrical Power Convention is such that a suggestion made in the *Electrical Power Engineer* (the journal of the E.P.E.A.) is worth consideration. It is thought that the Convention arrangements do not provide enough time for the discussion of some of the real controversies of the electrical industry. Mention is made particularly of the Herbert Committee's report, productivity, automation, and the training of technologists. All these subjects were raised in the "Electrical Forum" at Torquay but were of necessity dealt with rather summarily. The suggestion is that such topics might be remitted to secondary parallel meetings and study groups, leaving delegates to select the field of the greatest personal interest to them. Although we say that the proposal is worth considering, there is the danger, of course, that its adoption might militate against the main purpose of the Convention which is to bring the different sections of the industry together; it might tend to the formation of segregated sectional groups.

DESTROYING INSECTS SCIENTIFICALLY

Of interest to the users of wood poles are two new weapons for the destruction of insect pests, which are being experimented with at Princes Risborough, described in the report of the Forest Products Research Board which has recently been published for the D.S.I.R. by H.M. Stationery Office. These weapons are gamma rays and high frequency currents. The laboratory experiments now being carried out with gamma rays in collaboration with the Radio Isotope Division of the Atomic Energy Research Establishment, Harwell, were begun following the recommendation of a committee which considered the use of this method for destroying the death watch beetles which infest the timbers of H.M.S. *Victory*. The work is intended to reveal the dosage necessary for either killing eggs, larvæ, and beetles, affecting the development of larvæ and causing them to produce sterile beetles or rendering the beetles themselves sterile. Experiments so far carried out on death watch, powder-post and common furniture beetles at various stages in their life-cycles show that irradiation can cause sterilisation or death.

The work with high frequency currents has been concerned with the destruction of wood-boring insects in woods of various thicknesses. It was found that all larvæ in wood treated by high frequency currents were destroyed when the temperature of the wood being treated rose above 60 deg C. Effective temperatures were reached during treatments lasting up to one minute when an output of 250 W at a frequency of 75 Mc/s was used. Further experiments are to be made using fields of greater power for shorter periods ranging up to 15 seconds.

Stella North

THIRD 60 MW SET COMMISSIONED IN 240 MW STATION

THE first three 60 MW turbo-alternator sets in Stella North generating station are now in commission and it now remains for only one further set to be put into service for the station to be completed. This 240 MW station occupies a site on the north bank of the River Tyne at Lemington in Northumberland about five miles from Newcastle-upon-Tyne. On the opposite bank of the river is Stella South generating station which houses five basically similar generating units with a total capacity of 300 MW (see *Electrical Review*, 19th August, 1955, pp. 337-343).

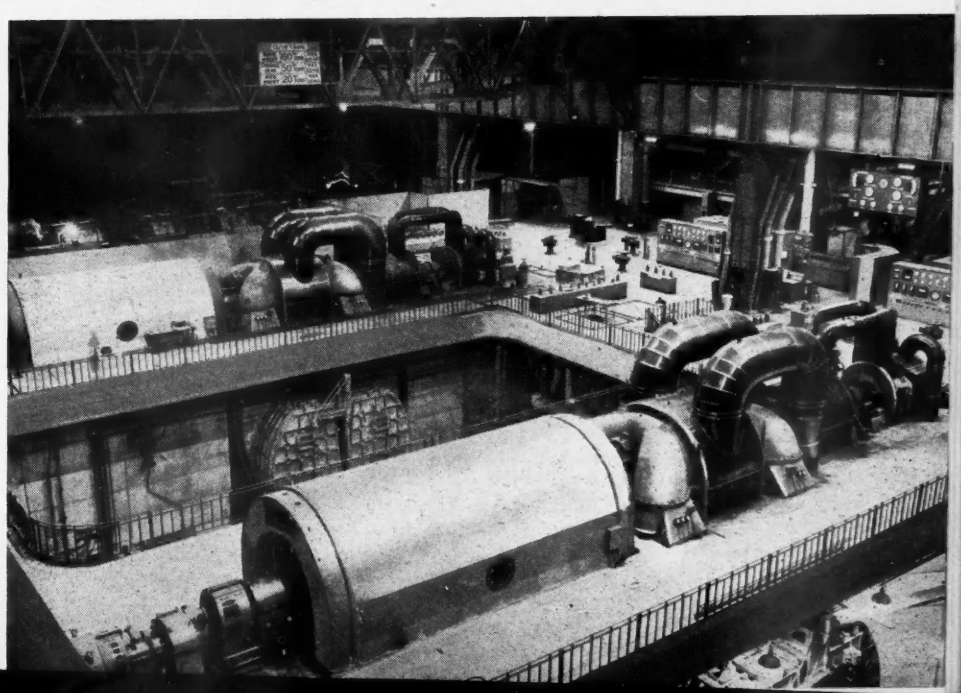
The two Stella power stations represent the third stage in the post-war reconstruction programme of the North-Eastern Division of the Central Electricity Authority and follow the installation of 100 MW of additional plant in Dunston " B " and the completion of the 240 MW North Tees " C " project. Unlike these two previous projects the Stella stations occupy entirely new sites which lie on the route of the 275 kV grid line to Carlisle.

The main station buildings are of steel framed construction, concrete encased and with brick panel walls, the boiler plant being served by two 375ft high brick chimneys. Coal supplies are by rail from local collieries and the site includes extensive rail sidings. Ultimately, the annual coal consumption will be 625,000 tons or 2,300 tons a day in winter. A reserve coal store of 109,000 tons maximum is provided with facilities for reclamation by transporter bridge.

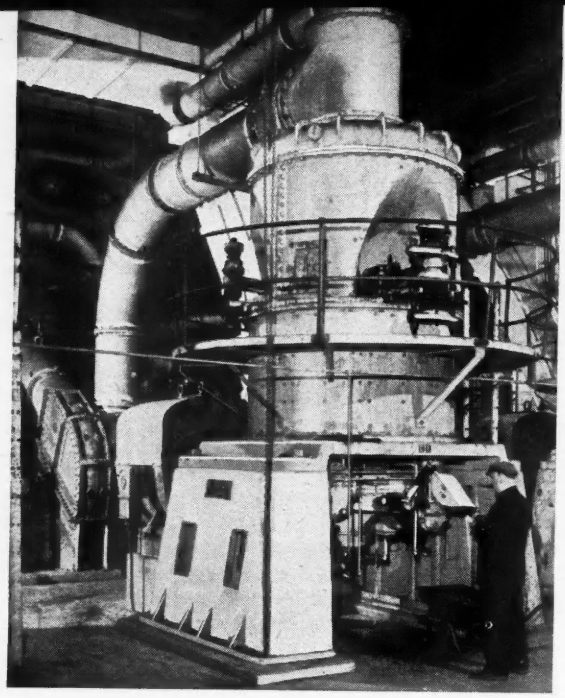
Four Clarke Chapman pulverised fuel-fired boilers are installed, each with an evaporative capacity of 550,000 lb/hr, the steam conditions at the boiler stop valve being 950 lb/sq in and 925 deg F. Ash and dust collected from the boiler furnaces and dust hoppers is loaded into barges and dumped at sea. Some 120,000 tons of ash and dust will be handled each year in this way. The four Parsons 60 MW turbo-alternators are arranged transversely in the engine room and each will take steam from its associated boiler unit. The turbines which run at 3,000 r.p.m. are of three-cylinder design, with double flow l.p. cylinders, coupled to hydrogen-cooled alternators generating at 11·8 kV. In view of the large amount of cooling water required for the Stella stations it was decided that Stella South should draw water for cooling directly from the river and that cooling facilities should be provided at Stella North by four cooling towers.

As already mentioned all coal is delivered to the station by rail and sidings are provided for the temporary storage of two days' supply of coal wagons and the same number of empty wagons. The operation of the sidings is such that full trains are drawn directly on to the four reception tracks by the British Railways locomotives and these full trains are then drawn off these tracks by the site locomotive and stored on six full standage sidings. From these sidings wagons are drawn off in groups of twelve and propelled to the filler pits. The empty wagons are then taken to the filler pit tracks and stored on the four empty sidings. A run round is provided for British Railway locomotives at the south side of the reception sidings and for the site locomotive at the south side of the filler pit tracks.

There are three filler pits, two of which receive coal from bottom emptying wagons while the third is supplied from a side discharge tippler. Each filler pit is capable of discharging coal, by means of electromagnetic vibratory feeders, at the rate of 300 tons/hr. The coal is conveyed by belting from the filler pits to the boiler house bunkers and/or the storage area and from the storage area to the boiler bunkers. All conveyor belts are of 300



The four 60 MW turbo-alternators are arranged transversely in the engine room



Four "Raymond" bowl mills serve each boiler

tons/hr capacity and travel at a speed of 350ft/min. At strategic points on the belt system overhead separators and magnetic pulleys are fitted to remove tramp iron. Automatic coal sampling equipment for station efficiency purposes is installed in one of the two junction towers and quality control sampling equipment for individual coal consignments is provided in the other. The coal store is served by a travelling gantry provided with two fixed radius grabbing cranes for coal reclaiming each grab having a heaped capacity of 2·5 tons. The coal store has a normal capacity of 92,000 tons (unconsolidated) when stacked to a depth of 14ft, while each boiler bunker has a capacity of 1,250 tons.

From the boiler bunkers an 11·5 tons/hr capacity roll type feeder delivers raw coal to the pulverising mills via an Avery automatic weigher. Four Clarke Chapman "Raymond" bowl mills size 613 serve each boiler unit and each mill is provided with a Keith Blackman exhauster fan driven through a flexible coupling by a 176 h.p. variable speed motor. Speed variations from 1,470 to 970 r.p.m. are obtained by means of a servo-motor controlled induction regulator.

After combustion has taken place the resultant ash is collected in the hoppers beneath the furnace of each boiler and is removed into a sluiceway by high-pressure oscillating water jets. At intervals along the sluiceway are water jets which direct the ash to one of the duplicate clinker grinders through which it passes before entering an ash pump. A valve in the sluiceway allows the water and ash mixture to be admitted to the selected clinker grinder. The water and ash mixture is then pumped from the ash sump by one of the three ash pumps to the ash and dust settling ponds. The pumps are of the centrifugal type each capable of delivering 1,900 gal/min of ash laden water against a total head of 90ft.

There are four reinforced concrete settling ponds each 285ft long by 30ft wide and 14ft deep. Water from these ponds drains through a bottom sand filter and overflows or can be decanted into a return water gulley leading to the drain sump. One of three 1,900 gal/min centrifugal type transfer pumps delivers water from the drain sump to the recirculating water reservoir. Alternatively, the water can be discharged to the river, in which case the h.p. recirculating pumps will draw water from the c.w. pump discharge culvert. The transfer pumps are in a building adjoining the settling ponds together with two sealing water pumps and a lancing pump. The water to these pumps is supplied from the cooling tower pond and ash quay swilling main.

The h.p. recirculating pump house and reservoir are situated between the ash pump house and the transfer pump house. The three h.p. recirculating water pumps are each designed to deliver 1,600 gal/min against a head of 275ft. The selected pump supplies the high-pressure water to the oscillating and ash sluiceway nozzles, and also to the ejector nozzles of the dust extracting plant.

Due to the difference in capacity between the ash and h.p. circulating water pumps the ash sump level will gradually fall. At a predetermined level, the selected thrustor valve will open and supply water from either the reservoir or the h.p. circulating water pump discharge to the ash sump. The l.p. thrustor valve is normally used when operating on a closed system, and the h.p. thrustor valve when on an open circuit taking make-up from the c.w. pump discharge culvert. Two 500 gal/min overflow pumps controlled by "No Flote" switches are provided in the ash pump house to drain the overflow sump adjoining the ash sump.

Dust is extracted from the precipitator hoppers by water ejector units and from the chimney bases by hydro-vactors. The h.p. water is taken from the recirculating pump discharge main and the resultant dust and water mixture discharged into the sluiceway. As already mentioned, the wet ash is removed by crane from the settling ponds and loaded into barges for disposal at sea. The complete ash and dust handling plant was supplied by Babcock & Wilcox, Ltd.

Steam Raising Plant

The completed station will accommodate four boilers manufactured by Clarke, Chapman & Co., Ltd. They are of the radiant type, fired with pulverised fuel and have a maximum continuous rating of 550,000 lb/hr, the pressure and temperature of the steam at the superheater outlet being 950 lb/sq in and 925 deg F. The combustion chamber is completely water cooled by 3¼in o.d. tubes pitched at $3\frac{5}{16}$in, the corner tubes being of finned construction. Pulverised fuel burners of the tilting type are accommodated in each corner of the chamber. A water-walled pass at the rear of the combustion chamber envelops the primary superheater and the economiser. The tubes in this section form the downcomers, supplying the furnace walls.

The horizontal type primary superheater is supported by sling rods from the building steelwork, while the economiser, situated directly below the primary superheater, is supported from the downcomer tubes. A damper controlled water-cooled chamber provides a path for gases to by-pass the primary section of the superheater, and serves as a subsidiary means of superheater steam temperature control. The boiler and superheater are suspended from the building structure, and all expansion takes place vertically downwards. Each unit is equipped with two Howden-Ljungstrom rotary regenerative air preheaters, and Sturtevant electrostatic precipitators.

Each boiler is equipped with one direct-mounted water gauge and one extended water gauge, together with one remote water level indicator, which is connected to the unit annunciator system. The water gauges were all made by Hopkinsons, Ltd. The feed water is regulated by a Cope's "Flowmatic" system, which is responsive to both boiler water level and steam flow. The boiler water level element consists of a thermostat tube expanding and con-

tracting with variations in water level. The " Flowmatic " controller consists of a spring-loaded diaphragm acted upon by the pressure differential across the superheater, thus giving a response proportional to steam flow. The movements of each element, thermostat and controller, are added together algebraically by means of a connecting chain link which transmits the resultant motion to a regulating valve in the feed supply line.

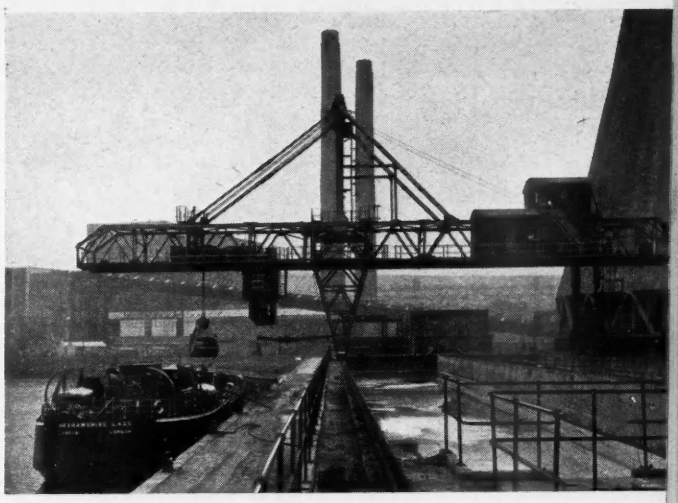
Steam temperature is controlled by means of corner firing tilting burners. The burners are positioned by Kent automatic air-operated tilting burner control equipment which will maintain full control of steam temperature between 70 per cent and 100 per cent of designed maximum steam output. The superheater gas by-pass damper is intended for use as a " setting " control, to cater for changes in cleanliness of the heating surfaces, abnormal operating conditions, etc.

The air heater equipment for each boiler comprises two CXZS 22 Howden-Ljungstrom rotary air preheaters having a total heating surface of 121,200 sq ft. Provision is made for an additional tier of elements 8in long to be fitted to each heater if required, thereby increasing the total heating surface to 141,400 sq ft. The design temperatures for air to and from the heaters are 100 deg F and 470 deg F respectively and for gas leaving the heater 280 deg F, at maximum continuous rating.

Each boiler is equipped with two forced and two induced draught fans of Howden manufacture. Each f.d. fan is of the single-box inlet backward-bladed type and is driven through a Vulcan Sinclair hydraulic coupling by a 224 h.p., 730 r.p.m. totally enclosed, closed air circuit, squirrel cage motor. The f.d. fans are situated at drum level and draw air from the space between the boiler tops and the roof above. The i.d. fans are of the double inlet type with self-cleaning impeller. Each is driven through a Vulcan Sinclair hydraulic coupling by a 479 h.p., 730 r.p.m. motor of the weatherproof, totally enclosed, closed air circuit squirrel cage type.

For each boiler there are 22 electrically operated Clyde soot blowers arranged to give sequence and/or selective operation. The steam supply for soot blowers is taken from the intermediate header between the primary and secondary superheaters. In addition, twelve wall boxes with blank flanges are fitted to receive future furnace blowers, and eight inner wall boxes with blank flanges for future economiser blowers, if required.

The electrostatic precipitation plant is supplied by the Sturtevant Engineering Co., Ltd., and comprises two electrostatic precipitators per boiler, each with their mechanical rectifier high tension sets housed in separate compartments. Dust laden gases leaving the air heaters enter self-cleaning flues, built as an integral part of the precipitator casings. These flues are provided with sloping bottoms and subsidiary dust outlets so arranged that any heavy dust particles which drop out of the gas stream, are automatically delivered into the main dust hoppers of the precipitator. The combined hopper capacity for two precipitators is 8,700 cu ft. Rapping gear is provided for the tubular receiving electrodes and the wire discharge electrodes and is actuated by electrically operated vibrators.



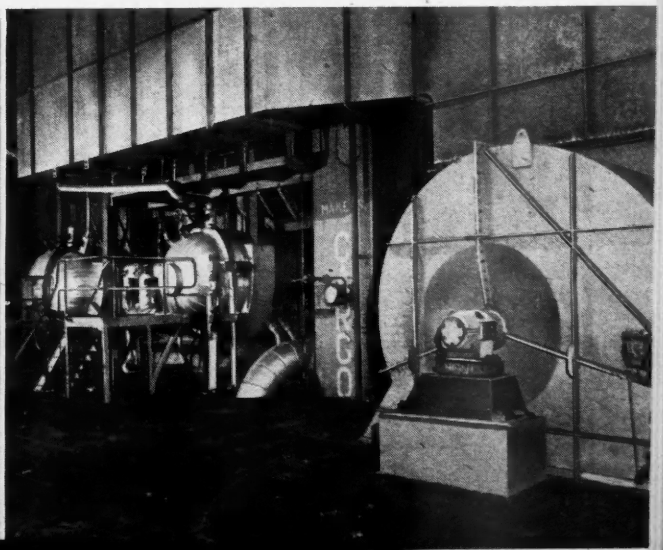
There are four reinforced concrete ash settling ponds, from which the wet ash is loaded into barges for disposal at sea

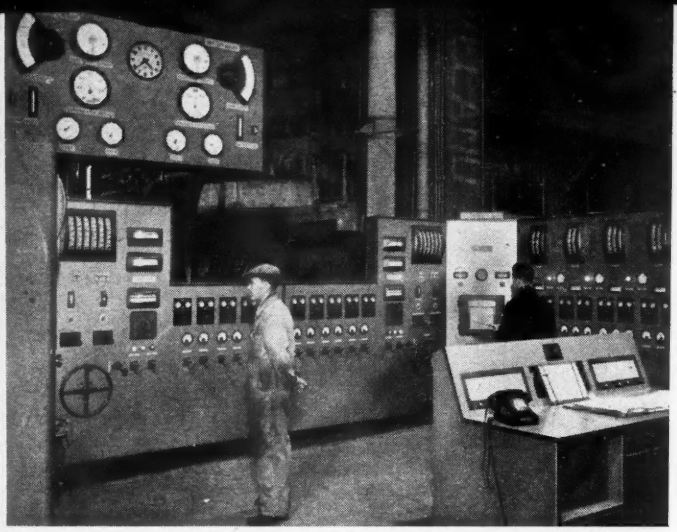
Boiler Control Equipment

The boilers are equipped with a Bailey automatic system of control the object of which is to ensure that sufficient steam is available at the turbine stop valve for the load on the turbo-alternator at any given instant, at the same time maintaining efficient combustion in the boiler. The operating medium is compressed air supplied from two Broom & Wade compressors having a capacity of 50 cu ft/min of free air at 100 lb/sq in.

A master controller measures the steam pressure at the turbine stop valve, compares it to the desired value and sends out an air loading pressure proportional to the difference between the desired and actual values. This signal which takes the form of an alteration in air pressure from the normal standard is passed through a master selector valve which enables the operator to allow the master pressure controller to control the boiler or alternatively to put the boiler on hand control. The outgoing

Left: Ash is collected in hoppers beneath the furnace and removed by high-pressure water jets and (right) the f.d. fans are at boiler drum level





Nos. 1 and 2 boilers are controlled from this panel

pressure of the master selector valve is then transmitted to two groups of boiler auxiliaries, namely, mill groups to increase the coal supply and i.d. fans to increase the air supply. Under normal operating conditions three mill groups are in service at maximum output. The coal feeder and exhauster motor speeds are controlled by induction regulators, while the i.d. and f.d. fan speeds are controlled by Vulcan Sinclair hydraulic couplings.

Turbine Arrangement

The four Parsons turbines are designed to operate with steam conditions before the turbine stop valve of 900 lb/sq in and 900 deg F and to have an output of 60 MW at both maximum and economical continuous rating. They are of the three-cylinder reaction type and run at a normal speed of 3,000 r.p.m. Steam is bled for five stages of feed heating giving a designed final feed temperature of 385 deg F. At a load of 60 MW and an absolute back pressure of 1·3in Hg the specified steam and heat consumptions are 8·432 lb/kWh and 9,258·7 B.Th.U./kWh respectively.

The cylinders are arranged in line. The h.p. cylinder is anchored at the exhaust end and the l.p. cylinder at the forward end, adjoining the exhaust end of the i.p. cylinder. The i.p. therefore expands towards the h.p. turbine. The h.p. and i.p. rotors are connected by a double-claw flexible coupling and the i.p., l.p. and alternator rotors are solidly connected. Residual thrusts in the h.p. and i.p. rotors are catered for by Michell thrust blocks; the thrust block fitted to the h.p. turbine is adjustable so that close axial clearances can be maintained under running conditions.

Three separate oil coolers each of 50 per cent duty, are provided for each machine. The main gear type oil pumps, driven from the h.p. turbine shaft, supply two separate systems, " lubricating " and " power " oil, when the turbine is running at speed. A motor-driven auxiliary oil pump is used during running up, emergencies and shutting down periods and operates in parallel with the main oil pump. The auxiliary oil pump is started automatically in the event of failure of the main oil pump. In addition, a d.c. motor-driven emergency oil pump starts up automatically in the event of failure of both the main and auxiliary oil pumps. This supplies oil to the bearings only. A motor-driven l.p. oil pump supplies oil to bearings when the turbine is being turned over by the 10 b.h.p. barring gear.

The " power " oil supply divides into two branches after passing the runaway trip plunger. One branch supplies pilot oil which transmits movements of the centrifugal governor to the steam governor valve oil relays, while the other branch supplies power oil as the operating medium for the governor and runaway stop valves. Operation of the runaway trip plunger allows the whole power oil system to discharge back to the main oil tank and shuts off further supply of oil. Oil pressure is thereby released from the runaway and governor valves and the valves close under the action of strong springs and shut off the supply of steam to the turbine.

Each machine is equipped with a centrifugal type governor which is mounted on a cross shaft at the h.p. end and driven by a worm and worm-wheel from the main turbine shaft. However, unloading devices are fitted to over-ride the speed governor and begin to close the governor valves if the vacuum or stop valve pressure falls below a predetermined level. To prevent the valves closing completely, with the consequent risk of the turbine being motored from the busbars should the vacuum or pressure continue to fall, an anti-motoring device is provided.

The turbine supervisory equipment records the rotational speed of the turbine shaft, eccentricity of the h.p. shaft, and the differential expansion between the h.p. shaft and cylinder at the exhaust end. Each of the measurements is carried out by a separate circuit the outputs of which lead into their respective recorders on the turbine gauge panel.

There are two Parsons three-stage air ejectors and one quick-start air ejector for each turbine. The three-stage ejectors are condensate cooled and each is designed to operate at a steam pressure of 600 lb/sq in, while the quick-start ejector is supplied with steam from the auxiliary steam manifold at the rate of 6,500 lb/hr and discharges directly into the atmospheric pipe.

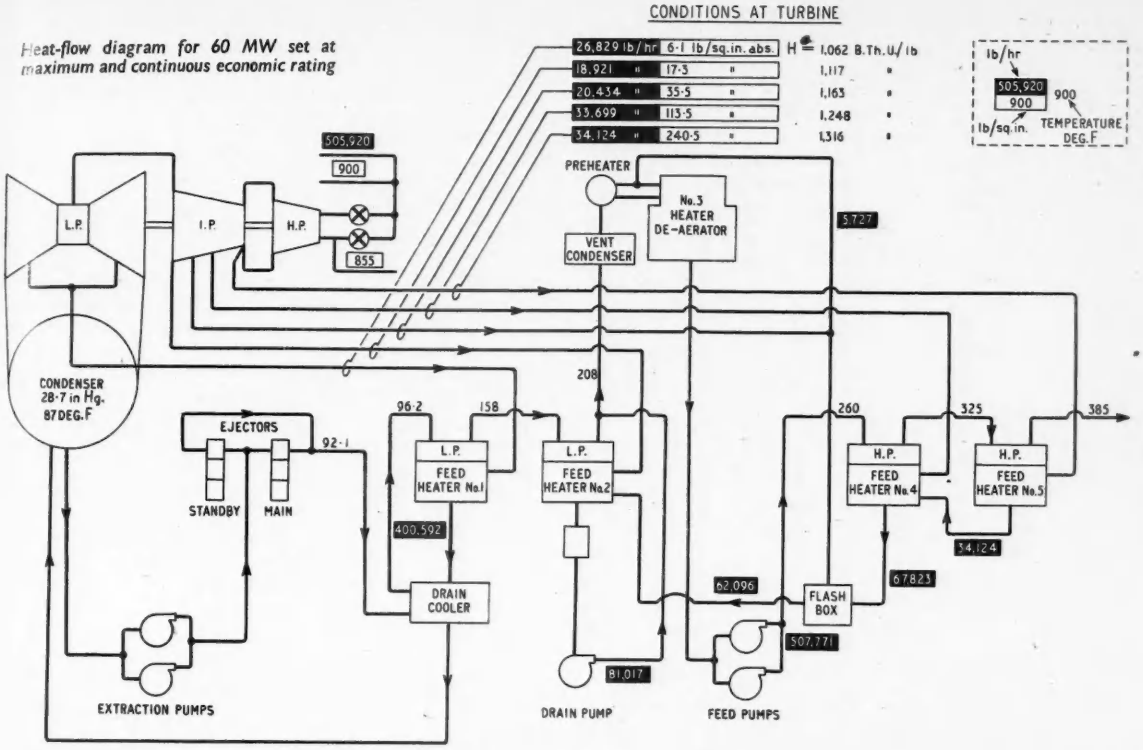
Two 100 per cent duty two-stage vertical extraction pumps, each with an output of 750 gal/min against a total head of 200ft, are driven by 100 b.h.p. L.D.C. motors at 975 r.p.m. When working in parallel each pump delivers 485 gal/min of condensate against a head of 220ft. The output from these pumps is governed by the water level in the condenser by the operation of a float controlled valve in the common discharge line from the pumps.

Feed Heating Train

The feed heating train consists of four surface heaters, one contact or de-aerator heater and a drain cooler. All heaters are of Parsons manufacture with the exception of the de-aerator heater which was made by Worthington-Simpson. Condensate is pumped from the condenser at 87 deg F by either or both extraction pumps and is fed via the condensate float operated control valve, through mains and/or standby air ejectors, drain cooler, l.p. heaters Nos. 1 and 2, vent condenser and preheater and then through nozzles of the de-aerator heater before entering the de-aerator storage tank. Two 100 per cent duty Weir feed pumps draw water from the de-aerator storage tank and discharge through Nos. 4 and 5 h.p. heaters, and via the main feed valve and Cope's regulating valve to the boiler. The feed pumps are eight-stage centrifugal units and each is driven by a 1,390 b.h.p. 3·3 kV English Electric induction motor.

The pumps, which can work in parallel, discharge through a non-return valve and isolating valve into the feed range before No. 4 h.p. heater. A thermally operated leak-off device (Hopkinson's) working in conjunction with a solenoid operated valve, discharges sufficient water through an orifice into the de-aerator storage tank to ensure a safe minimum flow of water through the pump. A by-pass incorporating a pressure reducing vessel is connected across each pump discharge non-return valve. This connection provides a flow of water through the standby pump sufficient to maintain it at operating temperature.

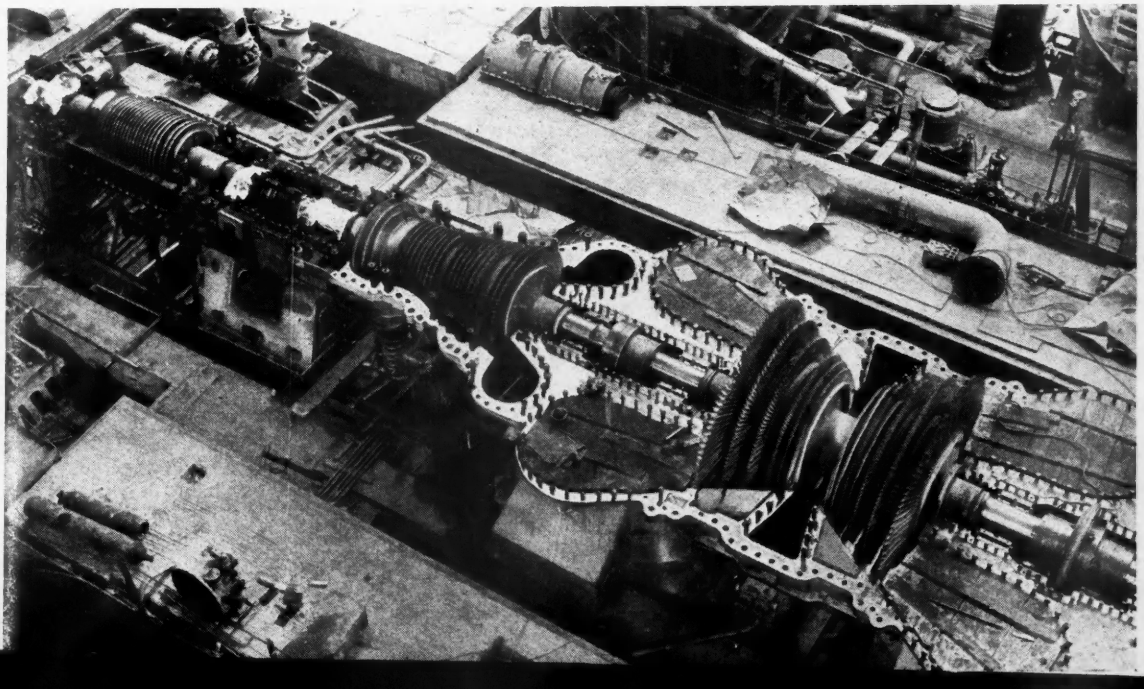
Heat-flow diagram for 60 MW set at maximum and continuous economic rating



The boiler feed consists of turbine condensate and about 1½ per cent of treated town water. This make-up water, which is obtained from a Permutit "Deminrolit" plant has a high degree of purity. The plant is designed for two half-duty sections each capable of producing a final maximum through-put of 6,450 gal/hr, giving a total of 12,900 gal/hr when the two sections are operated in parallel.

Each turbine is provided with a Parsons condenser of the surface type having three passes, the total cooling surface being 57,000 sq ft and the normal cooling water requirement 38,000 gal/min. The condenser is so arranged that half of its cooling water side can be isolated for cleaning purposes while the turbine is operating at reduced load. The tubes are expanded into the tube plate at the inlet ends and have packed glands at the outlet ends, while a row of iron bars is fitted above the condenser tubes to prevent damage to the tubes in the event of l.p. turbine blades being shed. An automatic atmospheric relief valve is connected to one of the exhaust trunks of the l.p. turbine. The water for sealing the valve is supplied from the extraction pump discharge via a tank fitted with a float controlled valve. Each condenser is fitted with a water level gauge and a float operated switch to give audible warning of high water. Provision is made for the installation of a 1,000 sq ft dump condenser for each unit to facilitate hot starting after a short shut down. Steam to this condenser is taken from the main steam pipes before the

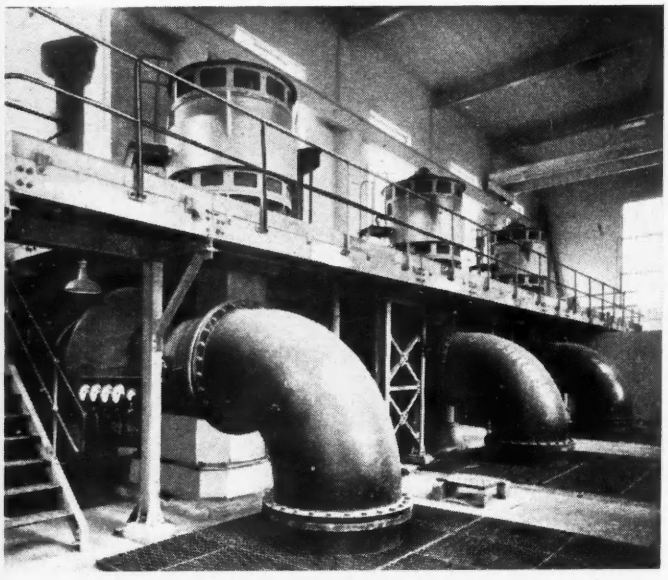
60 MW turbine during construction in Stella North



turbine isolating valves and is de-superheated by condensate from the ejector discharge before entering the condenser. The condenser shell has an atmospheric vent to the turbine drain vessel and the condensate goes to the make-up tank. Both steam and condensate de-superheating valves are electrically operated from the turbine control panel and are interlocked to ensure correct operational sequence. Circulating water is taken from the inlet culvert to each main condenser and returns via a 12in pipe to the outlet culvert.

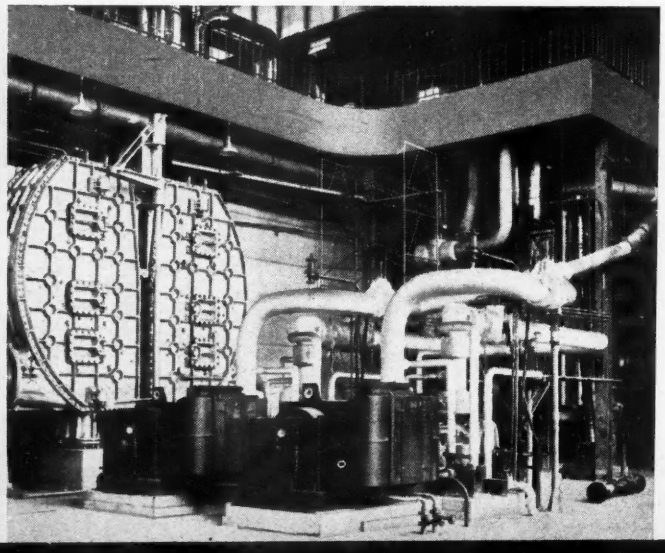
The chlorinating plant, supplied by Wallace & Tiernan, Ltd., is designed for chlorinating the condensers and auxiliary cooling plant of each of the four turbo-alternators in rotation, the quantity of water required for each unit being 40,200 gal/min. The capacity of the master chlorinator is 4,000 lb of chlorine per 24 hours and the control is by means of an automatic intermittent programme clock. The injector water pump of the centrifugal type was made by Holden & Brooke, Ltd., and designed to deliver 120 gal/min at 135 lb/sq in. It is driven at 2,900 r.p.m. by a 27·5 b.h.p. L.D.C. squirrel cage induction motor. River water is used for injection and town main water for control and auxiliary purposes.

The circulating water system forms a closed circuit with four natural draught cooling towers, make-up to the system being pumped from the River Tyne which is tidal. Both the c.w. and make-up systems are designed for remote operation from a control panel in the turbine house. A mimic diagram is provided on the control panel together with visible and audible auto-trip alarms for each of the c.w., make-up and air exhauster pumps.



There are four 42,000 gal/min c.w. pumps

Each turbine exhausts into a 57,000 sq ft three-pass Parsons condenser



Cooling System

The Davenport cooling towers are of reinforced concrete construction and have an internal stack of Scandinavian redwood laths which are supported on a framework of prefabricated ferro-concrete units. The internal diameter at the base of each tower is 184ft and the height from the rim level of the pond to the top edge of the tower is 238ft. The area of water surface of each pond is 26,322 sq ft which, at a depth of 14ft, equals 10,250 tons of water. A sump is provided in each pond to enable sludge to be removed using portable pump equipment.

The cooling water is fed to the tower irrigation system through a reinforced concrete conduit across one diameter of the tower to which are connected 4in and 6in bore pipes and patent self-adjusting brass sprayers which are screwed into them. Carry-over eliminators are fitted above the irrigation system to reduce precipitation to a minimum. De-icing facilities are provided by spraying warm water at the air inlet to the tower. This supply is taken from the c.w. outlet culvert and led to a double ring main situated between the lower edge of the tower shell and the pond sill. Each tower is designed to deal with the circulating water from one 60,000 kW turbo-alternator and is capable of cooling 2·6 million gallons of water per hour from 82·5 deg F to 70 deg F when the temperature of the air is 57 deg F with a humidity of 70 per cent.

The c.w. pump house is situated near the centre of the cooling tower outlet flume, on the cooling tower side, and accommodates the four Sigmund pumps which take c.w. from the cooling tower outlet flume and discharge it into a ring main supplying the condensers. Each pump runs at 490 r.p.m. and delivers 42,000 gal/min against a generated head of 72ft measured between the centre line of the pump discharge and suction branches. The pumps are driven by 1,150 b.h.p., 3·3 kV Laurence, Scott squirrel cage induction motors arranged for direct-on starting.

The make-up pump house is situated at the river side adjacent to the ash ponds and accommodates make-up and purge water pumps, air exhausters, bilge pump, and c.w. screening plant.

The 60 MW 11·8 kV hydrogen-cooled alternators and the gear driven air-cooled exciters are of C. A. Parsons manufacture. Circulation of both hydrogen and air is by means of fans mounted integral with the rotor and exciter shafts. Heat is transferred from the hydrogen to the river water in two stages. In the primary cooling stage, one of two vertical centrifugal motor driven pumps, running at 1,460 r.p.m. and capable of delivering 700 gal/min against a discharge pressure of 17·5 lb/sq in, pumps distilled water through a closed loop formed by the gas coolers and two surface type heat exchangers. In the secondary stage river water passes from the cooling water inlet culvert through strainers and heat exchangers to the cooling water outlet culvert. The distilled water extracts heat from the hydrogen in the gas coolers and transfers this heat to the river water in the heat exchangers.

To prevent excessive leakage of hydrogen between the rotor shaft and the stator frame, oil seals are fitted at each end of the stator casing. Arrangements are made for the sealing oil to be supplied either from the "power oil" supply or directly from the main oil tank. The a.c. motor-

driven gear type, main hydrogen seal oil pump, runs at 1,440 r.p.m. and delivers 60 gal/min of oil against a discharge pressure of 50/60 lb/sq in. As a standby a smaller d.c. motor-driven gear type seal oil pump is provided.

The exciter is gear driven at 1,000 r.p.m. and consists of a pilot and main exciter mounted on the same shaft. Excitation control is provided by a motor-driven rheostat in the field circuit of the main exciter. A Metrovick automatic voltage regulator of the Tirril type is fitted to each alternator. A feature of the exciter is the negative winding which provides a small constant magnetic field in parallel with and opposing the main exciter field. This permits the use of a smaller rheostat than would otherwise be necessary for the wide range of excitation required. In addition, a motor operated rheostat is provided in the control circuit of the regulator with sufficient range to enable the regulator to operate between +5 per cent and −20 per cent of rated alternator voltage.

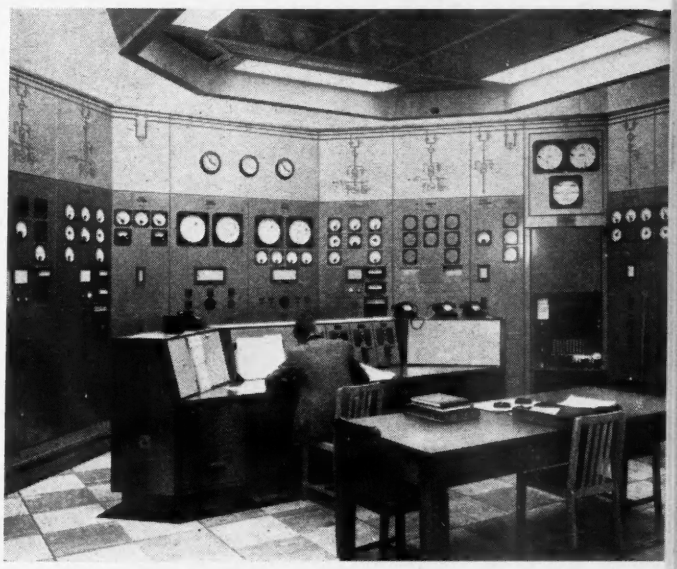
Electrical Connections

Each alternator is solidly connected to both a 6 MVA 11·8/3·45 kV unit transformer and a 72 MVA 11·8/141·6 kV unit transformer. The latter transformers, which are situated in outdoor cells on the west side of the main building, are connected to the 132 kV switching station in a compound on the opposite side of the incoming rail sidings. The switchgear is Reyrolle air-blast type rated at 800 A normal current and 3,500 MVA breaking capacity at 132 kV and is designed for outdoor operation. Each unit can be connected to either of two busbars, "main" or "reserve," and consists of busbar selectors, circuit-breaker and isomaker. The circuit-breakers are three single-phase units mechanically and pneumatically connected, each having four air-blast turbulators in series with a sequentially operated isomaker. Each phase is operated by air from its own local air receiver. From the circuit-breaker side of the line isolators rigid connections are made to post type current transformers, and from the current transformers to the circuit-breaker. Rigid connections are also made between the isomakers, on the busbar side of the circuit-breaker, and the top of post mounted insulators. Cable connections are taken from these terminals to a three-phase local overhead line extending from the reinforced concrete posts carrying the initial connections from the overhead line terminal tower to reinforced concrete posts situated midway between the "main" and "reserve" busbars.

The main busbars which run the length of the switchgear compound, can be split into two systems by a bus section switch in the centre of the main busbar. Similarly, the reserve busbars can be made into two sections by rotary type bus section isolators in the middle of the reserve busbars. Two bus coupler switches are situated at the ends of the busbars.

The system of connection for generators and station transformers is essentially as described for circuits supplying the overhead lines except that there are no line isolators. The incoming underground cables are taken to sealing bells mounted on steel supporting structures and from there rigid connections are made to the earthing switches mounted on the reinforced concrete posts which carry the local overhead lines. Provision is made for emergency by-pass connections on all feeder circuits and involves a physical disconnection of the affected switch unit and the use of jumpers to complete the circuit between the local overhead line and the outgoing side of the line isolators. With the reserve busbar selectors closed one of the busbar coupler switches can be used as the circuit switch for connection to the main busbar.

The system of interconnection between the station, unit and auxiliary boards is very similar to that in the South station. A unit transformer is connected solidly to the output terminals of each alternator and under normal running conditions supplies an associated 3·3 kV unit board. The unit boards can also be supplied from the station boards which are supplied by station transformers 1 and 2 taking their supply from the 132 kV busbars. The two station boards can be interconnected to operate on a common or sectionalised system depending upon plant conditions. The unit and station transformer circuit-breakers may be operated remotely from the control room or locally at the circuit-breaker panels. Each unit board supplies through a unit auxiliary transformer a unit boiler 415 V board and a unit turbine 415 V board.



General view of the control room

Supply to Auxiliaries

The two station boards each supply through associated transformers, turbine house boards 1 and 2, boiler house boards 1 and 2, make-up pump house boards 1 and 2, maintenance building boards 1 and 2 and lighting and heating boards for turbine and boiler house supplies. In all cases it is normal to supply these 415 V boards through their respective transformers, but it is possible to supply the No. 1 board through the No. 2 transformer by means of a change-over isolating switch. In addition, from each station board a supply is taken at 3·3 kV to ash plant boards 1 and 2. From these boards two 415 V ash plant boards are fed by transformers which can again be interconnected to feed either board.

The consulting engineers for the station are Merz & McLellan, while the main contractors are:—Civil engineering works, Sir Robert MacAlpine & Co., Ltd.; boilers, Clarke, Chapman & Co., Ltd.; turbo-alternators, C. A. Parsons & Co., Ltd.; switchgear, A. Reyrolle & Co., Ltd.; ash handling plant, Babcock & Wilcox, Ltd.; coal handling plant, Birtley Engineering Co., Ltd.; feedwater treatment plant, Permutit Co., Ltd.; de-aerator and general pumps, Worthington-Simpson; cabling, London Electricity Board.

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Toughened Glass Insulators

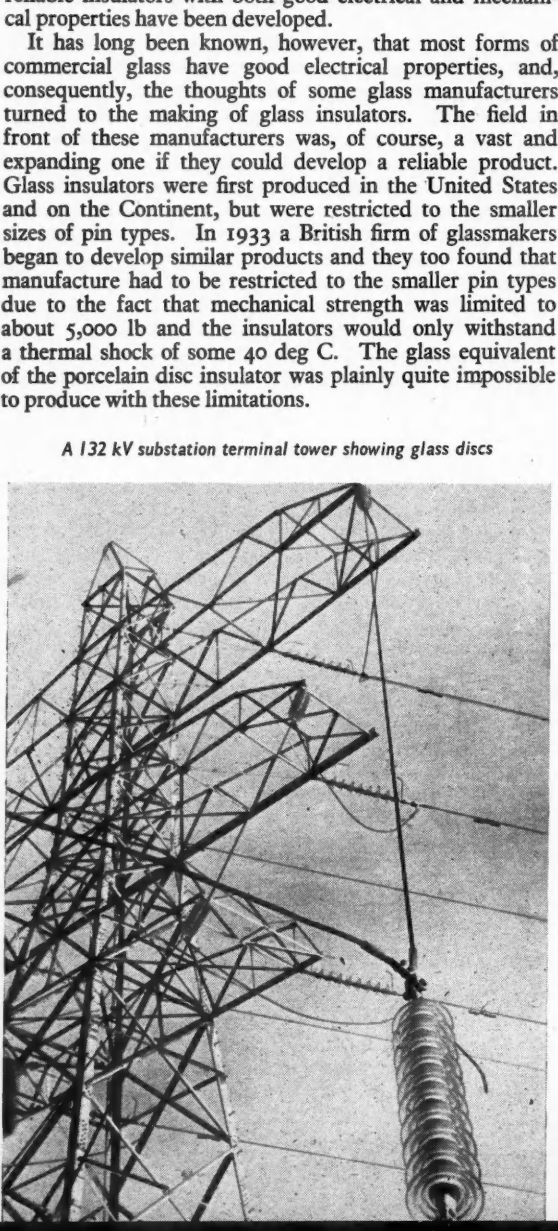
Advantages of Their Use on Overhead Lines

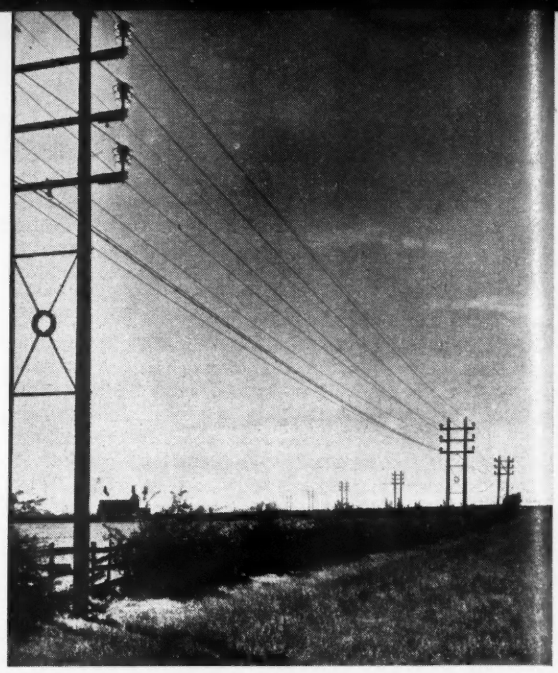
By C. KINMOND DOWNIE*

SINCE overhead lines have been used for transmission and distribution purposes the principal form of insulation has been the porcelain insulator. This type of insulator made of china clay and finished with a high glaze has been developed over the years. Improvements in design and manufacturing methods have been progressive, and very reliable insulators with both good electrical and mechanical properties have been developed.

It has long been known, however, that most forms of commercial glass have good electrical properties, and, consequently, the thoughts of some glass manufacturers turned to the making of glass insulators. The field in front of these manufacturers was, of course, a vast and expanding one if they could develop a reliable product. Glass insulators were first produced in the United States and on the Continent, but were restricted to the smaller sizes of pin types. In 1933 a British firm of glassmakers began to develop similar products and they too found that manufacture had to be restricted to the smaller pin types due to the fact that mechanical strength was limited to about 5,000 lb and the insulators would only withstand a thermal shock of some 40 deg C. The glass equivalent of the porcelain disc insulator was plainly quite impossible to produce with these limitations.

A 132 kV substation terminal tower showing glass discs





Double circuit 33 kV line using pin type glass insulators

In producing commercial glass for general purposes a process of annealing is carried out. This prevents distortion and cracks and relieves the glass of internal stresses which would be set up if the cooling of the finished product were uncontrolled. This same process was initially applied to the manufacture of glass insulators. It was, however, obvious that this method of manufacture could never produce insulators which would compete seriously with porcelain and the British manufacturers turned to the now well-known toughening process which up to that time had been applied to flat glass only. Their efforts and experiments proved so successful that in 1935 they were able to produce the toughened glass insulator which is so well known to-day.

The process of toughening is to introduce into the glass during manufacture certain controlled stresses—the insulator is, in effect, prestressed. After moulding, the glass is reheated to ensure a uniform temperature throughout the piece. It is then artificially chilled by compressed air under a very carefully controlled process. As a result of this chilling the outer surface of the glass cools much quicker than the interior of the piece and the outer skin takes up a very high state of compression. The interior glass is conversely in a state of tension. The resulting insulator has such increased mechanical and thermal characteristics that the limitations associated with the earlier annealed glass insulators are entirely overcome.

Since the interior glass, which is in tension, is surrounded by the outer compressive skin it follows that any break in the outer skin will release the interior forces and a progressive system of tearing will take place, which results in the complete disintegration of the piece. It is true to say, therefore, that so long as the insulator is physically complete it is electrically sound. This feature, peculiar to the toughened glass insulator, is referred to again. The toughening process made it possible to produce not only pin type insulators of the larger sizes but also disc insulators, since the requirements of B.S.137 could now be met without difficulty. Production started in 1935 but the outbreak of war in September, 1939, delayed developments, and it was not until the cessation of hostilities that large scale production was achieved and considerable quantities of these insulators have since been supplied to both the home and overseas markets.

* North of Scotland Hydro-Electric Board.

It is natural to compare the performance of toughened glass insulators with their well tried porcelain counterparts, and in this connection comparative tests have been carried out by the E.R.A. and the manufacturers have considerable test experience available. In addition a substantial amount of operational experience is now becoming available in this country.

This point is illustrated by the large numbers of toughened glass discs now in use all over the country both on 275 kV and 132 kV lines. To a lesser degree pin type toughened glass insulators have been used on lower voltage lines, and here again operational experience is being obtained. All the test results seem to show that the toughened glass insulator is both mechanically and electrically in no way inferior to a porcelain unit, and operational experiences so far seem to confirm this.

Glass and Porcelain Compared

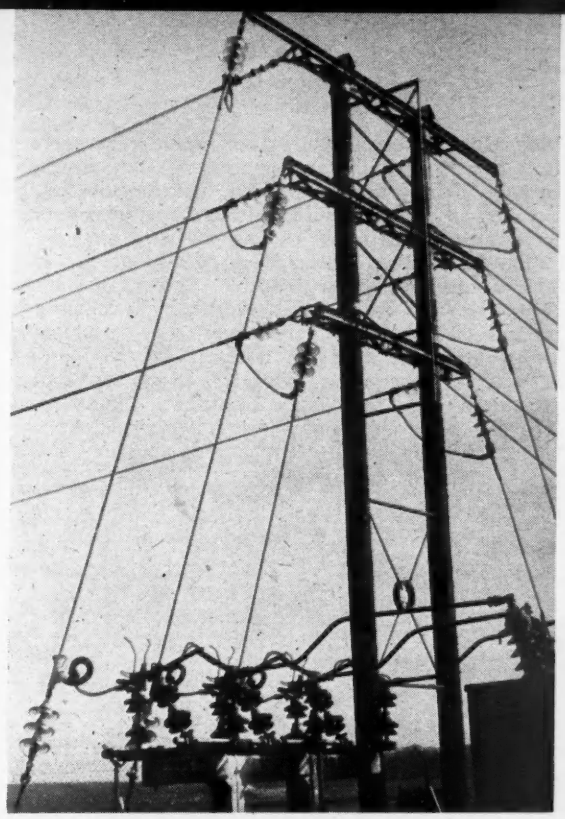
It has already been mentioned that a toughened glass insulator can only be in one of two conditions, either completely sound or completely disintegrated. It is in this respect that it differs so widely from a unit made of porcelain, and therefore, this feature must obviously be carefully considered in comparing the two types in use.

Considering first a new line on any voltage, the risk always exists that a porcelain insulator which was perfect when it left the stores may be damaged by the time it is erected. Moreover, the damage may be such that it can only be seen at close range. It could consist of a slight chip which would not materially affect the life or the efficiency of the unit, or it could take the form of a crack, difficult to detect prior to commissioning but which would ultimately endanger the working of the line. A toughened glass insulator, on the other hand, will, whether it be dropped from a truck or struck by a carelessly wielded spanner, either have survived injury or be completely disintegrated. In other words, there is no fear of its being erected with some hidden or undetected flaw. Some site engineers have also suggested that the toughened glass unit stands up better to rough handling in the field.

Any insulator in service is, generally speaking, liable to damage from four main causes: mechanical damage due to stone throwing, gunshot, or other causes; puncture by lightning strikes; electrical damage from flashover following lightning surges or for other reasons; and breakdown following deterioration due to ageing in service.

Comparison must now be made of the relative performance of both glass and porcelain units under these conditions. Mechanical damage will cause partial or complete breakage of a porcelain unit, depending on the force of the mechanical shock. If the damage is partial only, such as a crack, it may remain undetected for some time. With toughened glass, however, the unit will either survive intact or completely disintegrate and is readily located by inspection from the ground.

It should, of course, also be pointed out here that the damaged porcelain unit may remain in satisfactory service for many months or even years, whilst a total failure of the glass unit could lead to an immediate outage of the line, particularly on lower voltage lines, unless it is earthed through an arc suppression coil. Indeed, it is on this point, perhaps more than any other, that opinion as to the suitability or otherwise of glass insulators is most clearly divided. Is it better to have a line continue in service with defective insulation, which will probably lead to final breakdown, or is there an advantage in having a line outage, repairing the damage and then know that the line is sound so far as insulation is concerned? There is much to be said for both points of view.



A 33 kV substation terminal pole

This 10in diameter toughened glass disc was damaged by flashover in service on a 33 kV line

With regard to the second cause, puncture by lightning, it is claimed that a glass unit is virtually unpuncturable and so far this claim has been borne out in service. The modern porcelain unit also, of course, has a very high resistance to puncture but none the less it can and does occur. It is worth noting here that tests carried out by the National Physical Laboratory showed that the average electrical breakdown value for glass was some three-and-a-half times that obtained for porcelain.

Electrical damage appears to resolve itself into damage due to thermal shock caused by the intense heat of the power arc. Under these conditions the performance of the two types of insulator is not dissimilar. In one of the illustrations a toughened glass 10in disc is shown after having been subjected to flashover in service. The unit was one of a string of three on a 33 kV line, and the patrolman found two of the discs completely disintegrated and the third damaged as shown. This unit has since

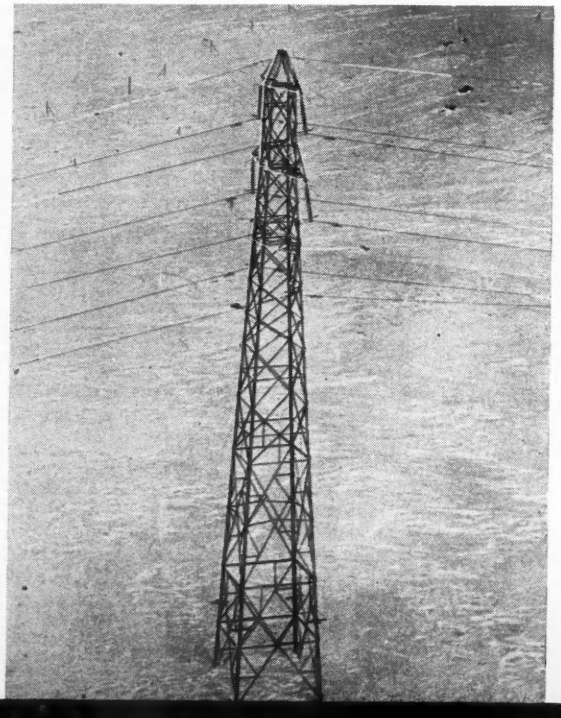
been returned to the manufacturers where it has successfully withstood all the tests applied to a new insulator. In spite of its scarred appearance, therefore, it may be regarded as a sound unit, and, in fact, the line remained in service until an insulator change was arranged.

The last cause of breakdown, ageing, cannot occur with a toughened glass insulator. There can be no deterioration in service because the high compressive strength of the outer skin of the unit cannot be overcome by any loads met in service. Consequently, the development of crazy cracking or hair cracks at stressed surfaces, which may lead to ultimate breakdown, cannot occur. The life of the insulator unit is, it is claimed, therefore limited only by the life of the metal fittings. Similar claims cannot be made in respect of porcelain units.

The tracing of faults on overhead lines can be a laborious business and may involve patrolmen walking for many miles. The fault may not finally be traced until a climbing inspection has been carried out, since a bad crack in an insulator held together by a tight binder is frequently not visible from the ground, particularly in darkness or in bad weather. With toughened glass, however, the unit if faulty will have completely disintegrated and it can readily be seen even by unskilled men using torches during darkness.

In the north of Scotland area a double circuit 132 kV line operates between Fort Augustus and the East Coast. This line, insulated with toughened glass insulator discs, crosses over the Corrieyairack Pass at a height of some 2,500 feet above sea level. During the winter of 1954/55 the line became unserviceable on one occasion, and the cause of the trouble was believed to be due to ice forming on the conductors. Ground patrolmen set out prepared to meet many difficulties, not the least being snow drifts sometimes fifteen feet deep. In the interests of saving time and trouble it was decided to attempt an inspection from the air. The writer set off in a chartered De Havilland Rapide; the weather was clear, and thanks to a good pilot, the aircraft flew quite close to the line and the iced-up section was quickly located on the summit of the Pass. The interesting point arising from this flight was that all the insulators could clearly be seen and had any been damaged, and therefore disintegrated, they could have been located without difficulty. The photograph taken from the aircraft shows not only the ice on the conductors but illustrates the insulator strings on which every disc is visible.

Winter photograph from the air of the 132 kV circuit over the Corrieyairack summit (2,600ft). Ice loading and each individual insulator can be seen



In conclusion, therefore, it can be said with certainty that the performance of the toughened glass insulator is comparable with that of porcelain units, and indeed, it would seem to have certain advantages provided that the cost of the two types is also comparable.

Visit to Russia

C.E.A. Party's Impressions

THE July issue of *Electricity* (the journal of the Central Electricity Authority) contains a brief account of some of the main items of interest seen during the recent three weeks' tour of Russia by a party of eighteen C.E.A. engineers led by Lord Citrine, chairman of the Authority. The delegation say that they found many things of interest on the technical side but perhaps the most lasting impression was the friendliness of the people who welcomed them wherever they went.

Describing the administration of electricity supply in the country, the writer says that the whole of the planning and operation is the responsibility of the Ministry of Power Stations, which is one of the 56 Ministries, answerable to the Council of Ministers. For electrical purposes the country is divided into 58 divisions or districts, each with its own director and chief engineer responsible for operations inside their own division, including sales to consumers.

There is no advertising, sales promotion, or service centres, domestic use being confined mainly to lighting and radio, and a few small appliances such as kettles, hotplates and irons. Electricity does not appear to be used for space heating. Industry takes more than 80 per cent of the available supplies.

The Soviet Union suffered badly as a result of the last war and lost about 5,000 MW of generating plant. Since then, remarkable progress has been made. At the end of 1955 the installed capacity totalled 37,000 MW. Under the current five-year plan, i.e. by the end of 1960, plant capacity is expected to reach 75,000 MW—double the present capacity and double the rate of expansion found in western countries. It is intended within this five-year plan to commission 2,000 to 2,500 MW of nuclear power plants in those regions where alternative fuels are scarce.

A number of 100 MW sets and two 150 MW sets were seen in operation, the latter at 2,400 lb/sq in and 1,050 deg F, with reheat to about 970 deg F. Designs are being prepared for 200 MW units and some forward thinking is being done on 300 MW sets.

Transmission voltages in general use are 110 kV and 220 kV, but a " super grid " has been planned at 400 kV; the first line, from Kuibyshev to Moscow, has just been placed in service.

Work is being done on high-voltage d.c. transmission and there is an experimental line operating at 200 kV. Approval has been given for the construction of a 340-mile line operating at 800 kV d.c.

Hydro-electric development is receiving considerable attention and very large stations are contemplated, with capacities of up to 3,600 MW. Present and projected installations on the River Volga alone will have an aggregate installed capacity of over 10,000 MW.

VIEWS on the NEWS

By REFLECTOR

ONE reason for the long period which elapses between the proposal to build a power station and its completion is the time taken to secure the various necessary "consents." Usually the work is not commenced until this matter is settled, for nothing can be taken for granted. I remember the case of the proposed Kepier (Durham) power station where after years (I believe) of discussion and inquiry the decision went against the North Eastern Electric Supply Co., and the idea was dropped. The company received an *ex gratia* payment of £6,650 from the Ministry of Town and Country planning for the expenditure which it had incurred. Eventually the site, which the company had already bought, had to be disposed of by the British Electricity Authority, which by that time had inherited it. I may say that I agreed at the time with the decision against the erection of the station for it would have spoilt the view of Durham Cathedral —one of the finest in England.

★ ★ ★

What makes me think of Kepier is a report in the *Manchester Guardian* that the Gloucestershire County Council, on behalf of the Central Electricity Authority, is building an access road in the vicinity of the village of Berkeley where the C.E.A. proposes to erect one of its first two atomic power stations. So far this proposal has not yet reached the inquiry stage although application for consent was made last December. In view of the reiteration of the urgency of getting on with the production of atomic power I do not blame the C.E.A. for taking this risk. The *Manchester Guardian* report says that the Minister of Fuel and Power has indicated that he will not consent to the erection of the Berkeley plant until he has made up his mind whether or not the C.E.A. should be allowed to put up a station at Bradwell, Essex. This consent has now been given.

★ ★ ★

A man described as an electrical engineer admitted in bankruptcy proceedings recently that he had not made an income tax return since 1949. He said that he had a dread of forms and was afraid to fill them in. The official conducting the proceedings said he found it difficult to believe this, but many of us share this allergy although we may not give in to it.

★ ★ ★

Sometimes it is an advantage to be a "domestic" consumer; at other times the reverse. The proprietress of a boarding house at Southend, however, appears to have had the worst of both worlds. For electricity purposes she has been told that her premises are not "domestic"; yet when she wished to buy a thermal storage heater she could not do so because, according to the Commissioners of Customs and Excise, this would constitute domestic use. (Thermal storage heaters of this type are not subject to purchase tax on the understanding that they are confined to commercial and industrial applications.) Originally any use in hotels and the like was classed as domestic, but it has since been conceded that the heaters may be sold for installation in public rooms. Unfortunately, in the premises in question there were no rooms open to non-residents. Electricity tariffs for small hotels and boarding houses have, I believe, been under review for a considerable time and some concessions may be granted. A much better solution, however, would be the removal of the restrictions on the use of these heaters while keeping them tax-free. By providing an increased off-peak load, this would help Electricity Boards a great deal in carrying out their price-pegging policy.

★ ★ ★

An electric cooker is no light object to manœuvre in confined spaces and installation staffs are sometimes confronted with a tricky problem in negotiating stairs. Such a difficulty occurred recently in the South Eastern Electricity Board's Twickenham and Richmond District where, says the Board's journal *SeaBoard*, a consumer wanted "a high-level oven cooker or nothing," and it was found impossible to get this particular type of cooker up the staircase leading to the flat. The wiring foreman thereupon consulted the district commercial engineer, who suggested that by using a tower wagon the cooker could be passed through the first-floor window. The cooker was accordingly loaded on top of the wagon and driven through Twickenham—attracting the attention, I hope, of a good many local inhabitants—and the installation was speedily completed.

★ ★ ★

The New York underground railways, which have been losing passengers in recent years to other means of transport in an endeavour to entice passengers back have put into operation an air-conditioned train; music is also provided from a tape recorder. The New York Correspondent of *The Times* reports that on the trial run, the tunes (from Broadway shows) were nearly inaudible—except when the train stopped at a station—"drowned out by the roar of ordinary operation and by the noise from the new apparatus." I gather that while the New York Transit Authority is highly gratified with the results of the air-conditioning, it is less so with the musical experiment. I think it is open to question which is the lesser of two evils —the "roar of ordinary operation" or the tape-recorded music.

★ ★ ★

A notable event 50 years ago was the opening of Armstrong College, Newcastle-upon-Tyne, by King Edward VII (*Electrical Review*, 20th July, 1906). The ceremony coincided with the completion of a new wing, the original scheme having been started in 1887. The College, subsequently renamed King's College, was originally the Durham College of Science and was founded by Durham University in association with the Institute of Mining Engineers and other scientific bodies. The Electrical Engineering Department, included in the new wing, was at the time in charge of Professor W. M. Thornton, D.Sc., M.I.E.E.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

IT may seem impossible and also unnecessary to add anything essentially new to the technique of comparative resistance measurements so well developed by Wheatstone, Maxwell, Kelvin and Rayleigh, since the bridge types suggested later are really only variants of the original bridges devised by these classics. Yet it goes without saying that modern industrial, not to speak of scientific, requirements of precision and speed of the measurements are not always satisfied by these methods and that in many cases the resistances of the leads and the instability of the conditions of measurement (mainly temperature variations) introduce inadmissible errors. The special methods to reduce these errors or, what is more important, their influence on the results of the measurements, are therefore always interesting and particularly those resulting in a more or less complete compensation of these errors.

Some of these methods render the measurements more laborious and the bridges themselves more complicated. So far, the methods suggested by Wenner and Romanowsky answered best, and a further improvement was later obtained by Rosa. The author has contributed a simplification in the working and evaluation of the results of the last method and demonstrates the suitability of the procedure by examples of calibrations of standard resistors in the ratio 1:10.—"Comparative Measurements of Standard Resistors," M. Careggio, *Elettrotecnica*, Vol. 43, No. 4, pp. 206-209, April, 1956, in Italian.

Corona Interference

The equipment described represents a special version of the C.I.S.P.R. equipment for the measurement of parasitic oscillations due to corona effect on h.v. lines. Since it is obvious that this kind of disturbance is of a practically continuous character, investigations of corona interference must be put on a statistical basis, and only continuous and automatic measurements can supply data suitable for statistical evaluation.

The equipment satisfies the most recent stipulations of the C.I.S.P.R. when the signal level is between 15 and 50 μA (i.e., within the upper half of the scale of the recording instrument). Weaker input signals are affected by a comparatively strong attenuation of the equivalent noise level which, for low levels of the order of 5 μA, may reach 6 dB. The elimination of this disadvantage would have required an increase of the anode voltage and power of the output stage of the amplifier which would have been incompatible with the type of equipment intended. To a certain extent, however, this is compensated for by a high sensitivity of the detector, so that the equipment is a good compromise between requirements and possibility of achievement within a given economic frame. Two sets of this type, tuned to 150 kc/s and 1 Mc/s, respectively, will be taken into service shortly.—"Recording Equipment for Radio Interference Effects of H.V. Transmission Lines," J. Carteron, E. Fromy and B. Prokocimer, *R.G.E.*, Vol. 65, No. 4, pp. 203-208, April, 1956, in French.

Room Screening

It is a fact that the classic meshwork screens satisfactorily used for interference suppression in the early days of broadcasting are no longer suitable for this task. The reason is obvious, since the rather primitive meshwork screens have a useful attenuation only for frequencies up to 10-20 Mc/s and not much higher, so that short-wave reception is not protected by them at all, or alternatively, h.f. noises penetrate the screens. Comprehensive measurements in various countries have also shown that, apart from the steeply falling trend of the attenuation curve at high frequencies, there are particularly unfavourable resonance effects related to the mesh width, resulting in sudden "slumps" or "holes" in the attenuation curves.

Since, however, the problem of radio interference has nowadays become much more important than ever before, and the suppression equipment now fitted on many of the dangerous sources of interference is not always efficient enough to prevent interference with particularly sensitive receivers, special measuring devices, etc., screening has still to be resorted to in such cases, and a suitable type of screen evolved. According to the author's report, such a type now actually exists and takes the form of a meshwork of "honeycomb channels," based on the principle of cavity resonators operated below their critical frequency and producing an attenuation determined by the ratio of the length to the width of the resonator. This meshwork answers well for the construction of stationary as well as portable screening installations or cabins, and interesting details of the design of such cabins as well as test results are reported. —"Electromagnetic Screening of Rooms as a Method of Radio Interference Suppression," M. Bier, *E.T.Z.* (A), Vol. 77, No. 11, pp. 321-325, 1st June, 1956, in German.

Argon-Arc Welding

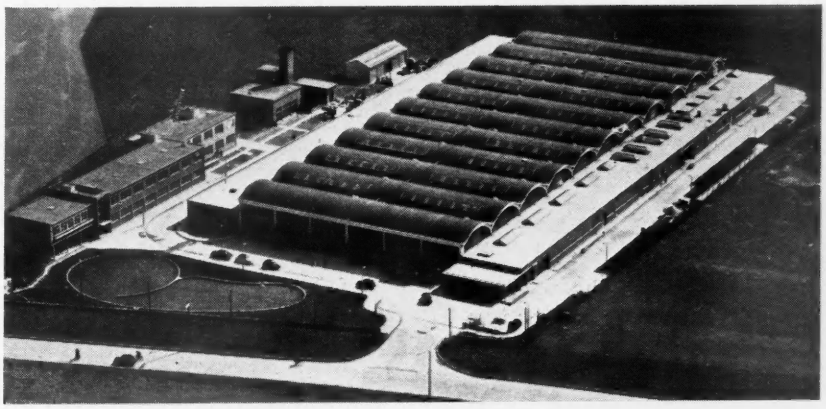
The many well-known advantages of the argon-arc welding method are opening ever new fields of application. In some cases, however, this is not feasible without modifications of the usual equipment. One particularly interesting example is the welding of aluminium conductors which is somewhat difficult, particularly in the case of thin conductors. This is in the main due to the fact that the outfits available are designed for welding currents of 150 to 550 A, the lowest current setting at which a stable arc can be maintained being about 30 A. With these currents aluminium welding is impossible.

The research laboratories of the MEZ-works in Brno developed a special argon-arc welding set for aluminium conductor welding, the main component of which is a transformer with 140 V secondary voltage and a current regulation range of 2.5-24 A, so designed that the welding current is almost independent of the arc voltage, and both of the arc length. The stability of the arc is ensured by an h.f. ioniser (5000 V at 3-7 Mc/s) with a two-stage spark gap. The equipment is supplemented by special (water-cooled) tungsten electrodes and tong-type wire holders with ceramic linings representing moulds to obtain smooth welds without beads. This equipment is particularly interesting in view of the fact that the world shortage of copper is bound to lead to a progressive replacement of copper by aluminium conductors, e.g., for transformers and machine windings.—"Outfit for Argon-Arc Welding of Aluminium Conductors, Mark TO35," K. Schwarz, *Elektrotech.Obzor*, Vol. 45, No. 5, pp. 237-240, May, 1956, in Czech.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Special-Purpose Alloys

NEW TELCON FACTORY AT CRAWLEY, SUSSEX



Aerial view of the factory

ABOUT thirty years ago the Telegraph Construction and Maintenance Co., Ltd., started making special alloys to improve the performance of submarine cables and, as a result of extensive research, "Mumetal" was developed, to be followed closely by "Radiometal" and "Rhometal". These high permeability materials have proved to be of great value to the electrical and radio industries generally and in particular to instrument and meter manufacturers. Many other special-purpose alloys were developed during the ensuing years, the duties ranging from electrical resistance and heating to glass sealing, magnetic and thermostatic bimetal. The increase in demand for these alloys has involved continued expansion of production units and it has been found necessary to leave the parent works at Greenwich and seek more extensive accommodation at Crawley, Sussex. Here a new factory has been erected and today the Telcon Metals Group possesses the most up-to-date metals plant of its kind in the country.

The Crawley works are situated on a site of about 10 acres of which 106,000 sq ft is devoted to factory space and 20,000 sq ft to offices and laboratories for research and development. The factory itself is rectangular in shape, 440ft long and 240ft wide and consists of two central bays each 80ft wide and two side bays each 40ft wide. The apparent absence of supporting columns when viewing the centre bay, which is 160ft wide and 440ft long, gives the visitor a striking impression of space. The factory has ample natural lighting and ventilation, but is heated by oil-fired boilers situated in a modern boiler house on the east side. Apart from space heating, steam is also used for production purposes and domestic hot water, the main process being the acid pickling which is contained in one of the bays on the west side.

Electric power is received at 11 kV and is transformed down to 440 V three-phase in two substations situated in the north-east and south-west corners of the factory. The lighting is carried out by tungsten filament convector type reflectors and renders operation at night as efficient as by day. There are several hundred motors installed on various plants whose power ranges from $\frac{1}{4}$ h.p. to 500 h.p., and also a number of h.f. motor-alternator sets for melting the alloys.

Pending the erection of a new factory within the grounds, the Sankey-Telcon Company has been temporarily housed in the administrative block. Here is being carried out both prototype and production work on the manufacture of castings by the "lost mercury" process. The merits of this procedure lie in the fact that the final castings are of such a precision nature that machining is either entirely avoided or reduced to a very small amount. It also makes it possible to produce finished parts which could not be made by any other method.

As far as possible, the siting of the plant has followed a definite plan with materials entering near the south-east corner and leaving near the gate on the north-western side. Altogether about 20 different alloys are produced and the ingredients are generally purchased as virgin metals, such as nickel, copper, iron, chromium, manganese, molybdenum, cobalt, silicon, aluminium, calcium, etc., although beryllium-copper is obtained in the form of a 4 per cent. master alloy. Minor constituents, viz., vanadium, titanium, and the like are purchased as ferro-alloys.

Melting Shop

The main melting plant consists of $\frac{1}{2}$-ton and $\frac{1}{4}$-ton induction furnaces, together with a $\frac{1}{4}$-ton vacuum melting furnace, and all are operated from motor-generator equipment. Beryllium copper melting will be located in a separate building before the end of the year. There is ample capacity to meet all demands at the moment and this could if necessary be stepped up by continuous operation.

The cogging mill is equipped to take rolls for producing basically either 6in or 2in slabs for strip, or $1\frac{3}{4}$in squares for rod rolling and wire. The main plan for strip production is to operate on square ingots weighing about 340lb each, cogging them down and subsequently rolling them in the three-high hot strip mill. After leaving this mill, the surface of the strip requires treatment which is carried out in the next plant.

The long strips are passed through a continuous descaling bath and scratched-brushed to remove all scaly and surface imperfections. They are then transferred laterally on to a conveyor for the continuous annealing furnace, after which they are ready for breaking down by cold rolling into thinner gauges.

Hot rolled strip is broken down on four-high mills and given intermediate annealings in suitable furnaces and atmospheres. The finishing is achieved by a batch of cold rolling mills of various types which reduce the alloys to the desired dimensions. One mill worthy of mention is the electronically controlled "Sendzimir mill" which gives a range of 0.020in down to 0.0006in, handling strip 6in wide and giving close tolerance on thickness. The

operation of this mill is complicated and involves precision grinding of roll cambers which is carried out in the roll grinding shop. A battery of slitters is available for cutting the strip to widths making it suitable for the production of laminations, cores, etc.

For the common types of rod and wire, material in the form of 1¾in squares received from the cogging mill is handled on the rod and bar rolling mill. Here the most common output size is $\frac{5}{16}$in diameter, but the mill can handle a wide variety of certain sections. Apart from a large output of strip of various thicknesses, the company specialises in the production of beryllium copper non-sparking tools and castings, and it is equipped with production facilities for making about 400 different types of tools.

A section of the side bays is devoted to the manufacture of all sizes of cores in "Mumetal," "H.R.C." and thin "Radiometal," mainly for the electrical industry. A section is also devoted to special heat treatment. Another bay is engaged on the production of a wide variety of "Mumetal" screens in the form of hand fabricated parts and pressings.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Contractors' Interests

YOUR leader in the 6th July issue was factual and terse. It may, however, give a wrong impression that the Electrical Contractors' Conference at Eastbourne was narrow and dealt only with matters of self-interest, rather than those which are all part of a great industry. At times brevity can be misleading.

I have missed only two conferences since 1926 and admittedly this is the first I can remember without a purely electrical subject. Nevertheless, it is wrong to assume that the National Inspection Council and the apprenticeship scheme have not received the attention of a large body of E.C.A. members. At Branches, Section Boards, regional conferences and Council meetings these two items have constantly been discussed in the last three years and almost without exception at every meeting during the last twelve months.

You may well ask "why have a paper like Budgetary Control" at a National Conference? Were we so very wide of the mark? Have we not had for some time an appeal from the Chancellor of the Exchequer to stabilise prices, or even to reduce them? Would not a knowledge of budgetary control help electrical contractors to achieve this national object? It appears as if a consideration of budgetary controls would have been beneficial at the British Electrical Power Convention; it might have avoided the announcement of a probable increase in electricity tariffs and the consequent withdrawal.

You did credit our worthy past-president, Mr. R. A. Marryat, B.Sc. (Eng.), M.I.E.E., with a reference to I.E.E. Wiring Regulations and installation inspection, but he also touched on electrical development and the solid fuel problem, the help we can expect from nuclear energy, the growth of and the further demands on the electricity supply, the help to industry by electronic adaptation—nowadays called "automation"—and what the Herbert Committee would like the supply industry to be. He also made an appeal for the Area Boards to compete with electrical contractors on fair commercial lines. He spot-lighted the new difficulties of the 13th Edition of the I.E.E. Regulation on earth-loop testing, particularly on the supply side of the consumer's terminals.

Regarding installation inspection, let me quote from the E.C.A. Presidential Address:—

> "During recent months progress has been achieved towards the formation of the National Inspection Council for Electrical Contracting. This body, supported by all organised sections of the industry, is intended to supersede all former attempts to register electrical contractors on a voluntary basis as a recognition of their technical and practical qualifications. The success of this scheme, the object of which is to protect the public against the lurking dangers inherent in the use of electricity, depends entirely upon the extent of the support afforded to it by the public. It is quite unnecessary for me to add to the remarks of coroners up and down the country as to the potential danger of electrical work performed by the unqualified which is not generally inspected at all until after a fatality has occurred, or the fire brigade has been called.
>
> "It would not, perhaps, be inappropriate for me to draw your attention to the report which was issued just a month ago by the Fire Research Board for 1955 in which reference was made to the steady increase in fires associated with the use of electricity. If present trends are maintained, the rate of electrical fires will be doubled in the next twenty years. In the meantime the Board has drawn attention to the need for constant care in the maintenance of electrical installations and to the dangers of additions to wiring by amateurs in existing installations.
>
> "Living as we do in a so-called Welfare State, it is indeed surprising that compulsory registration of qualified electrical contractors and electrical operatives has not been introduced long ago, as it has been in so many other countries, where often far less care for the individual is otherwise exercised. Possibly the absence of such compulsory registration here is an indirect reflection of the good reputation of all E.C.A. members. In a general sense I always prefer to avoid compulsion wherever possible, but if this state of affairs is to be allowed to continue, the public must be made properly aware of the inescapable risks of fire and shock inherent in amateur alterations to electrical installations, and in the work of unqualified and spare-time workers. Very shortly, all electrical contractors throughout the country will be invited to enrol with the National Inspection Council and we assure all concerned of our goodwill in making every possible endeavour to achieve the object for which this voluntary organisation is being brought into being."

He has not left a lot more to say on that subject.

Apprenticeship training is of great importance as you rightly state, and may I again quote from the President's address:—

> "What of our manpower resources? During the past 12 months we have reviewed very fully and comprehensively the whole question of entry into the industry and the training of apprentices to provide for this future expansion, recognising that we should indeed be lacking in our duty to the community if the service we render in the field of installation should lag behind public demand. It would be fair to say that the future will demand the greatest possible utilisation of the technical, administrative and organising resources which we possess and at the same time the provision of adequate training facilities so that the manpower resources of the industry will be efficient and sufficient for all needs. This, in my view, is the individual responsibility of everybody engaged in the industry, and although the Association will obviously play its part in any direction where it can be of service, I want to make it clear that the responsibilities rest with the individual and not the Association.
>
> "I should be lacking in my appreciation of the efforts of the membership at large and of the branches if I did not say at once that even the present scheme of apprenticeship training would be impossible of operation without the immense amount of voluntary assistance given by members at their local technical colleges and by the branches through the apprenticeship awards which they make. At the same time as many eminent men have made it clear in recent months, the

responsibility of the electrical industry to society is going to grow immensely during the next decade or so and there must be a sufficient reserve of trained men available to meet the demands which the new era will make. Men will be required for the installation and maintenance of an ever-increasing number of electrical machines and appliances and we must play our part in education to-day."

I am grateful to the space you have kindly given me. It is typical of your independent policy that your comments often point out the duty of one section of the electrical industry to another. You criticism in this case will do good.

Walsall. H. F. TRUMAN,
Truman Electrical Co.

How Low is a Safe Voltage ?

I THANK Mr. Mann for his comments on my article, and he raises some important points. I still think that to a man working on a ladder or catwalk a shock at 55 V can be as dangerous as one at 240 V, and I suggested that it might be more dangerous in view of the fact that with a centre-tapped transformer there are twice as many chances of a shock at the lower voltage than from a normal 240 V supply. Mr. Mann says that America has managed with 115 V, but we also know that many new extensions there are being made at 230 V.

I have read many articles and papers, and seen many diagrams purporting to "prove" that under certain circumstances a voltage trip cannot work, but practical experience has a disconcerting way of upsetting many of these theories. The simple fact remains that, with proper placing, the leakage trip coil is in parallel with the consumer, and should he be exposed to a lethal voltage, or anything in excess of about 20 V, the trip will operate. If, by a combination of circumstances, he is not so exposed the trip will not work, which seems to me to be fair enough.

Elham, Kent. T. C. GILBERT, M.I.E.E.

Earth Fault Protection

I HAVE noticed with interest Mr. Swann's article "Earth Fault Protection" in your issue of 13th July, and in particular the illustration at the top right-hand of page 58, which shows a B.T.H. switch-fuse incorporating a fuse "striker" device acting as an earth fault relay connected across a core-balanced current transformer secondary winding.

Mr. Swann will recall the several discussions he had with me and Mr. Dannenberg in 1944 when we jointly were proposing this idea, which indeed was the subject of a patent and was incorporated in much of the air-break gear being offered by my employers, Johnson & Phillips, Ltd., at that time. The subject was discussed in some detail in an article by Mr. Dannenberg and myself which appeared in the *Electrical Review*, Vol. 135, p. 113, in 1944, and also in an I.E.E. paper by me entitled "Excess Current Protection by H.R.C. Fuses on Medium Voltage Circuits" (see *Journal* I.E.E., Vol. 92, Part II, No. 29, October, 1945).

It is therefore most interesting to find that Mr. Swann includes this method of providing earth fault protection in his present article, because it may be fair to assume that he still believes the method has possibilities; alas, my experience in 1944/45 did not encourage the continued use of the idea simply because users objected to the problems of renewal.

Reference to the article in the *Electrical Review* and to the I.E.E. paper will show that the use of a striker element of the now well-known tripping fuse as an earth fault relay was not restricted to the application which has been noted by Mr. Swann.

In particular a valuable application appeared to us at that time to be a unit comprising a core-balance transformer, fuse striker, and an auxiliary contact which the striker would operate to light a lamp or ring a bell, the whole being enclosed in a sheet metal box with two cable sealing boxes, so that it could be inserted in an existing feeder cable to give warnings of earth faults.

Finally, it did appear (see p. 423 of I.E.E. paper) that, subject to further experimental work, the idea could be used to provide open-circuit protection (single-phasing) by connecting the striker element across the open-delta secondary of three small single-phase voltage transformers. In my experiments in 1944 these transformers were of the type used for toy electric trains with a secondary voltage of 12 V.

Wraysbury, Near Staines. R. T. LYTHALL, M.I.E.E.

Does Domestic Electrification Pay ?

THE electricity industry will need more convincing evidence than that advanced by Major Banner's article in your issue of 6th July before it can establish that it pays householders to use electricity for all purposes, including main space heating. One householder's comparison of his bills when using electricity only, in 1937 and 1955, with those when using combinations of fuels in another house in earlier years does not prove anything; nor does the unsupported statement that electricity costs are probably little different from those when coal and/or coke is used.

All we can deduce from Major Banner's figures is that at 1.1d per unit electric heating costs him 2s 9d per useful therm. With Group 4 coal at 6s to 8s per cwt the cost of heat works out at from 1s 3d to 1s 8d per useful therm when a convector open fire is used.

London, S.W.1. J. S. WILLIAMS,
Director,
Coal Utilisation Council.

ABACS OR NOMOGRAMS

The above is the title of a book by A. Giet which is to be published by Iliffe & Sons, Ltd., on 31st July. It has been translated from the French by Miss Helen Phippen, a senior research assistant at the Science Museum, South Kensington, and edited by Mr. J. W. Head, mathematical consultant to the Research Department of the British Broadcasting Corporation. The original work has had considerable success in France, and it demonstrates the many and varied applications of the abac or nomogram, and it even shows how those without specialised mathematical knowledge may construct their own charts. It contains a large number of practical examples drawn from the fields of mechanics, physics and electrical engineering. Very few formulæ are outside the scope of nomograms if skilfully chosen auxiliary variables are introduced.

B.I.S.R.A. "Open Days"

The British Iron and Steel Research Association is to hold two "open days" at the Sheffield Laboratories on Thursday and Friday, 6th and 7th September, for representatives of member firms to demonstrate the progress made since the premises were opened in November, 1953, by the Duke of Edinburgh.

Electrical Industries Benevolent Association

THE annual meeting of the Electrical Industries Benevolent Association was held on 12th July at the Cable Makers' Association Offices, London.

Mr. H. Riley

Sir Harold Bishop, president, who presided, said that an increase of over 10 per cent in the amount given to the Association's beneficiaries in hard cash had become a commonplace year by year, but that the amount of work which it did for its beneficiaries in solving problems which were not in themselves financial was growing even faster.

Mr. L. C. Penwill, in proposing the adoption of the annual report and accounts, paid tribute to the Association's voluntary workers throughout the country. Mr. F. E. C. Miller, chairman of the Finance Committee, in seconding the proposal, said that the Association had paid its way but that the amount it had had to pay out had increased faster than the amount of the funds coming in.

On Sir Harold Bishop relinquishing the chair, Mr. Harry Riley, the incoming president, paid tribute to the work done by Sir Harold and Lady Bishop during his presidency.

New members of the Council elected were Sir William Darling, Mr. F. E. C. Miller, Mr. E. A. V. Peckham, Mr. E. E. Rosen and Mr. C. R. Spouge and new appointments as members of the Court of the Association were Mr. R. A. Marryat, Mr. F. E. C. Miller and Mr. H. H. Mullens.

Mr. C. R. King, a past-president, a member of the Nottingham Branch of the Association for over twenty years and a member of the Council for many years, was appointed chairman of the Court.

The report for the past year says that the celebrations of the Association's golden jubilee also saw a still further development in the work of the Association, an increase in its funds to meet its growing benevolences, and the acquisition of the larger headquarters. It refers to some of the cases in which the Association has been able to give valuable help. Grants made to those who needed financial help amounted to £45,271, an increase of £4,536 over the previous year. Broome Park has continued to provide a haven for those who through age and infirmity are unable to look after themselves in their own homes. The total voluntary revenue income for 1955 was £57,167, an increase over 1954 of £3,437. The report states, however, that still further efforts will be needed from the Association's supporters in collecting its revenue, in view of the increasing amount paid out in grants, pensions and allowances last year, and it appeals for new recruits to the ranks. Reference is made to the success of the jubilee luncheon held in April last and of the many gifts made to mark the golden jubilee year, and a tribute is paid to the late Mr. H. A. Deacon, who had been the chairman of the Court.

Contracts for Kariba Project

THE Federal Power Board of Rhodesia and Nyasaland announced last week that it had reached a decision on the award of the main civil engineering contract for the Kariba Gorge hydro-electric scheme on the Zambesi River, and also on contracts for the 140,000 b.h.p. water turbines, generators, power transformers, overhead electric travelling cranes, shunt compensating reactors, and transmission lines.

Tenders for the main civil engineering contract were received from five separate groups of contractors and opened in Salisbury on 17th April. Three groups made offers which were keenly competitive for a contract of such magnitude. Following a very thorough evaluation of all factors involved, the Board concurred with the recommendation of its consulting civil engineers to accept the tender of Impresit (South Africa) (Proprietary), Ltd., modified to its satisfaction. A company to be called Impresit (Kariba) (Pvt.), Ltd., would be created to undertake the work.

The revised tender price of Impresit South Africa (Pty.), Ltd., for a selected top water level of 1,590ft was £25,278,000. This was £1,466,000 less than the next lowest tender and £2,271,000 less than the third lowest. The various works would be carried out to a precise schedule so that initial power might flow at the beginning of 1960.

Much of the preliminary work at the site associated with the contract, such as the river diversion tunnel and cofferdam foundations, had been carried out by the Cementation Co., and these works would greatly facilitate compliance with the timetable for the main civil engineering works. A temporary power plant of some 6,000 kW capacity and certain other constructional plant to be used in connection with the works and for the camps would be obtained from Britain.

Tenders for the six electrical and mechanical contracts also closed on 17th April and the Board had been advised on them by its consulting electrical and mechanical engineers, Messrs. Merz & McLellan. In comparing these tenders certain allowances in respect of efficiency, cost of civil works and other technical factors had to be made with the result that the lowest prices were not in all instances the most favourable tenders. Generally, tenders were strongly competitive. Prices at which the contracts had been awarded were subject to adjustment in accordance with variations in the cost of materials, labour, freight, insurance and Customs duties and the ultimate expenditure by the Board on each contract might be higher or lower than the figure quoted, but in all cases the prices were limited by an upper ceiling. The awards were as follows:—

Five 140,000 b.h.p. water turbines (seven tenders received), Boving & Co., Ltd., London, £1,072,583. Five 100 MW generators (eighteen tenders received), Metropolitan-Vickers Electrical Export Co., Ltd., £1,772,065.

Power transformers (sixteen tenders received): Generator transformers (10), English Electric Co., Ltd., £622,500. Substation transformers (13), Ferranti, Ltd., £1,333,200. The generator transformers would be single-phase 15/18/330 kV units and the substation transformers three-phase units with maximum ratings of 120 MVA for Kitwe and 60 MVA elsewhere.

Two overhead electric travelling cranes for power station (eleven tenders received), Babcock & Wilcox, Ltd., £108,292.

Shunt compensating reactors (eight tenders received), C. A. Parsons & Co., Ltd., £191,920.

330 kV steel tower transmission lines (eight tenders received), Rhodesian Power Lines (Pvt.), Ltd., Salisbury, £9,935,844. Line conductors would be twin 0.35 sq in steel-cored aluminium carried on steel towers. In carrying out the contract, considerable quantities of British equipment would be used.

Decisions remain to be taken in the next few months on the following contracts: Main and auxiliary switchgear, 330 kV and ancillary cables, 330 kV switchgear and 11 kV air-blast switchgear, transmission line survey south of Broken-hill and civil engineering works including intake gates, screens, gantries, draft tube gates and tailrace outlet stop-beams. The estimated cost of these contracts is £4 million.

PARLIAMENTARY REPORT

Restrictive Trade Practices Bill

WHEN the House of Lords considered the Restrictive Trade Practices Bill in Committee, Lord Jessel said there was much uncertainty in industry about whether agreements in force at the time that a registration order was made would have to be registered, or only those operating when the registration period came to an end.

Lord Mancroft, Under Secretary, Home Office, said the Government would introduce an amendment to provide that particulars of an agreement made before the registration order came into force and which was terminated or varied before the end of the registration period need not be furnished to the Registrar, although particulars would have to be furnished of the varied agreement in its new form. On the assumption that the Bill would pass into law at the end of this month, it was the Government's intention to lay and publish the first registration order before Parliament adjourned for the summer recess. This meant that industry would have three months before Parliament approved the order, together with the actual period of registration, in which to consider whether to abandon or modify an agreement.

Lord Gridley moved an amendment to allow the Restrictive Practices Court to decide that a restriction was in the public interest if its removal would be likely to have a serious and persistent adverse effect on the carrying out of technical education, research and development in the industry concerned. He said that in order to meet the growing shortage of technologists, craftsmen and other men for design and research tasks, engineering industries were spending much money in assisting apprentices during their education. In the electrical industry about £12 million a year was being collectively spent on research, development and technical education. He wanted to ensure that firms who spent large sums on this should be listened to when they claimed that part of their expenditure should be treated as a proper working expense and must be covered in the price to the consumer.

Lord Lucas of Chilworth and Lord Woolton said that they thought Lord Gridley's argument should be addressed to the income tax authorities and not to the Restrictive Practices Court.

Lord Mancroft, replying for the Government, agreed with this view, and pointed out that adequate provision already existed in the Bill for agreements based on research and development to be deemed to be in the public interest. This provision was intended to cover restrictions which conferred a clear benefit which otherwise would not be available to the industry or the consumers of the goods in question. Thus it might be argued that common research activities were facilitated by restriction of competition in prices or output since the manufacturers concerned would, in those circumstances, be more ready to pool their contributions to technical advance. He found it difficult to see how technical education could be affected by restrictive arrangements in the supply of goods. The Government agreed with Lord Gridley on the need for improved technical education and had launched a programme of expansion, but he could not see how the amendment would further the admirable cause which everyone had at heart.

Lord Gridley, after explaining that he had sought to find some words which would enable industry to say that in their charges they had a right to include the cost of research, technical education and development, withdrew his amendment. He said that no one could know how this Court would operate and to what kind of criticism industry's arrangements might be subjected.

Lord Mancroft later moved a new Clause to bring Part II of the Bill (which prohibits agreements for the collective enforcement of resale price maintenance) into operation within three months of the passing of the Bill. He said this period would allow manufacturers who had hitherto relied on collective resale maintenance to adjust their contracts of sale, taking account of the prohibition on collective enforcement and of the new powers of individual enforcement. It was recognised that manufacturers might need a breathing space for making these adjustments. Assuming that the Bill became law at the end of July, the Clause would bring this part of the Bill into operation at the end of October. It was proposed that the rest of the Bill would come into operation immediately on enactment.

The Committee stage was concluded.

Rural Supplies in Scotland

In the House of Commons last week Sir David Robertson asked the Secretary of State for Scotland if he was aware that the North of Scotland Hydro-Electric Board was not providing supplies of electricity to meet the demands of ordinary consumers in a number of agricultural areas in Caithness and Sutherland, and had given the Government's directive to cut capital expenditure as the reason.

Mr. J. Stuart said that already over 90 per cent of the potential consumers in Caithness and Sutherland had been connected, including 278 up to the end of May this year. The supply of electricity in any particular area was a matter for the Board and must be governed by its financial position as well as by the Government's request to reduce capital expenditure.

Mr. John MacLeod asked if the Minister was aware that the Hydro-Electric Board was now asking exorbitant capital charges for taking electricity to these remote areas, which was surely not a correct interpretation of the 1943 Act.

Mr. Stuart said the Board, by Statute, was required to balance its budget.

Sir David Robertson said it was also a statutory obligation on the Board to bring electric power to the people, including those in the remote areas. The moment the credit squeeze began all distribution to those areas stopped. He asked the Minister to take action to see that the Act of Parliament was carried out.

Mr. Stuart: "I think it is very creditable that over 90 per cent of the potential consumers have been connected."

Mr. Woodburn said there were complaints that the Government had not carried out the promise given in the Crofters Act to give assistance to crofters, who were anxious to have electricity.

Mr. Stuart said he was not aware of that.

Questions on Nationalised Industries

Mr. Hobson asked the Prime Minister if he would now give instructions to Ministers responsible for nationalised industries to answer questions about matters arising in the annual reports and accounts of the appropriate industries.

Sir Anthony Eden said this question had been frequently considered. He did not, however, think that any change in the rules in regard to questions about the nationalised industries was called for.

Mr. Hobson said that in the accounts of Cable & Wireless revenue from subsidiary companies was included, but it was impossible to find out what companies these were, even by reference to the relevant Act.

Sir Anthony Eden said that if the House was able to have a debate on the accounts of the nationalised industries it would be useful to discuss this point.

Scientific Manpower

Mr. Callaghan asked the Minister of Labour if, in connection with the scientific manpower census, he would ascertain to what extent directors and managing directors of companies possessed scientific and technological qualifications, and if he would investigate to what extent experienced, as distinct from newly qualified, scientists and technologists were leaving this

country for work in Canada or the United States.

Mr. Iain MacLeod said this scientific manpower inquiry was almost completed. It would not be possible to ascertain what directors and managing directors possessed scientific and technological qualifications without reopening the inquiry and putting a new question to employers which he would not feel justified in doing at this stage. With regard to the question of emigration to North America, the inquiry related to qualified scientists and engineers in this country. The available statistics of emigration did not provide the information asked for on this point. He expressed appreciation of the way in which industry had co-operated in the inquiry.

TV Interference with Radio

Mr. Leavey asked the Postmaster-General what steps he would take to protect radio reception from interference caused by television reception.

Dr. Hill said that where a television set caused interference with sound receivers which were themselves in proper working order, the Post Office offered the owner of the television set all possible advice to help him cure the trouble. The question of designing television sets so as to avoid such interference was primarily a matter for the radio industry. Under the Act of 1949, wireless apparatus was specifically excluded from his powers, but he could assure the House that the Post Office was receiving very real co-operation from the manufacturers and almost invariably from the owners of television sets.

Radio Position-Finding Service

Mr. John Profumo, Parliamentary Secretary, Ministry of Transport, told Mr. Hector Hughes that the Decca Navigator system was a valuable medium-range aid to navigation. Since 1947 four chains of stations had been installed in the United Kingdom giving complete coverage of the sea areas around our coasts. The latest of them, the North Scottish chain, should be particularly useful to fishing vessels, more than 300 of which were already equipped to use the service. Three other chains had been installed in Europe and he understood that further extensions were planned. The Decca Navigator Company provided and maintained the transmitting stations in the United Kingdom and hired and maintained the receivers used on board ship. He understood that the charge varied from £275 to £395 a year according to the service the user required.

Reception in Sheffield

Mr. George Darling asked the Postmaster General whether he would examine the cost and all the technical considerations involved in erecting a transmitter in Sheffield for local diffusion of all present and future television services operating in the Yorkshire area.

Dr. Hill declined. He said the question of deciding the best means of overcoming reception difficulties at Sheffield was a matter for the broadcasting authorities. At present they were fully engaged on their main development programmes.

In reply to Mr. Whitelaw, Dr. Hill said that preparatory work had already started on the B.B.C.'s new television station at Sandale, near Carlisle. The permanent transmitters would be ready for service towards the end of 1957, though the B.B.C. hoped to provide a temporary television service before the end of this year. He hoped that a v.h.f. sound station at Carlisle would be included in the next stage of the v.h.f. sound programme, which he was now discussing with the B.B.C.

Price Pegging and Wages

Mr. Boardman asked the Minister of Labour if he would give an assurance that wage applications or negotiations covering those employed in nationalised industries would not be prejudiced by reason of any undertakings which had been given at the request of the Government not to increase charges or prices for limited periods.

Mr. Iain Macleod said there was, in the nationalised industries, joint negotiating machinery for the settlement of terms and conditions of employment. The Government had no intention of undermining the responsibility of the authorities concerned with the operation of these industries for considering wage claims and conducting negotiations through the joint machinery .

Mr. Frederick Lee asked the Chancellor of the Exchequer whether, in view of the undertakings on price stabilisation obtained from the nationalised industries, he would seek similar undertakings from the private sector.

Sir Edward Boyle, Economic Secretary, said the Government did not consider a specific appeal to private industry appropriate but they had emphasised to representatives of both industry and labour the importance of maintaining stability in costs and prices.

Telephone Progress

THE second annual report of the Telecommunication Engineering and Manufacturing Association (for 1955-56), records the world telephone progress during 1954. The United States heads the list of principal countries, the number of telephones installed having risen from 50.4 millions on 1st January, 1954, to 52.8 millions on 1st January, 1955, representing 32.21 per 100 of population. The total of installation in the United Kingdom is much below these figures, being 6,483,000 at 1st January, 1955, an increase during the year of 344,000, and representing 12.74 per 100 of population. The United Kingdom ranks ninth in the list of countries given as far as telephone density is concerned, and the report states that in view of the remarkable rate of growth in other countries, it would appear unlikely that this country, in view of the restrictions placed on growth, will be able to improve its relative position for many years to come.

Referring to exports, the report states that the Customs and Excise returns for the year ended 31st December, 1955, show that exports amounted to £18 million, as against £17.5 million in 1954. Radio apparatus and equipment for long-distance radio telegraphy and telephony, and radio relay equipment for multi-channel telephony, telegraphy and television, are not brought out separately in the returns and are therefore, not included, but several million pounds should, no doubt, be added to the figures on this account.

Member companies, apart from supplies to Commonwealth countries, have contributed to the growth of communications networks in many countries of the world. Competition has been severe. The recovery of Germany and its increasing influence in the export market has been an important contribution to this situation and the possible effect on our competitive ability of further wage increases is viewed with alarm.

The Post Office accounts and statistics are reviewed and the report includes sections on education and training and outside activities of the Association.

Manchester Electronics Exhibition

The eleventh annual convention and exhibition of electronic equipment and instruments to be organised by the Institution of Electronics, Northern Division, was held from 12th to 18th July at the College of Technology, Manchester. Altogether 68 manufacturers of electronic devices and research associations took part in the exhibition which appeared not so much to be the vehicle for introducing new products and techniques but rather more to provide interested engineers in the North of England with an opportunity of seeing some of the apparatus which had previously been shown at other exhibitions in London. The equipment on view ranged from electronic measuring instruments and controls to sound reproduction equipment, printed circuits and high frequency heating equipment. Apart from the exhibition staff a series of 31 lectures on electronic and allied subjects was delivered to interested visitors and selections from some 30 films on electronic topics were also shown.

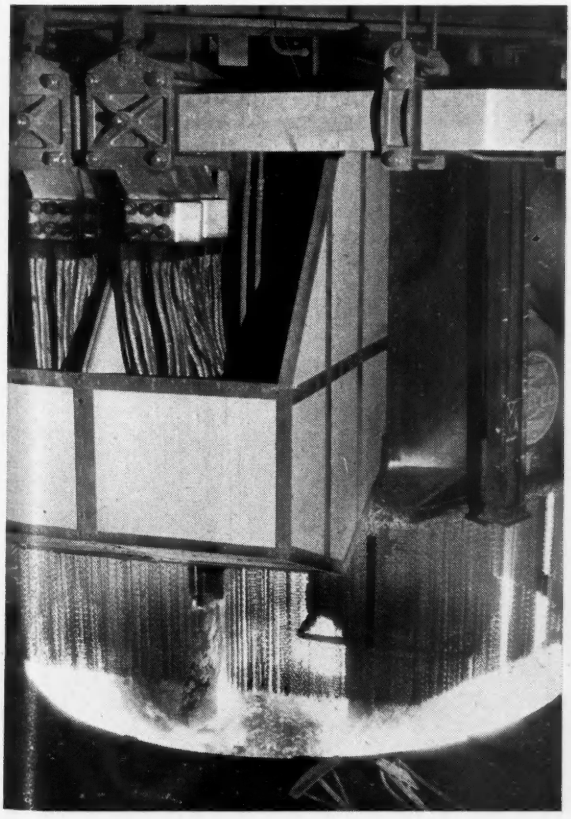
Prefabricated Busbars

Supplies to Large South African Furnaces

WHAT is perhaps the largest aluminium busbar contract yet undertaken in this country and exported abroad has recently been completed by Barlow & Young, Ltd., Westminster, London. The entire busbar system, complete with all hangers, steelwork and ancillary equipment, was manufactured by them and then packed and shipped to South Africa. It is now in service supplying current to two 7,500 kVA smelting furnaces at the Witbank plant of Ferrometals, Ltd., Johannesburg. The work was carried out in conjunction with Birlec, Ltd., Birmingham, who were responsible for the entire furnace contract.

Each leg from the transformers to the electrodes consists of 80 sq in of aluminium made up of 16in × 10in × $\frac{1}{2}$in bars, the weight of this metal alone being in the region of 16 tons. The bar was obtained from the British Aluminium Co., Ltd., hot rolled with a tolerance of plus or minus 0.015 in thickness, and was of electrical purity.

The length of run and site condition necessitated a very considerable amount of setting with angles to suit the existing site steelwork, and the clients in expressing their appreciation reported that the whole assembly had gone into position just as it had been received from this country. The electrode current approximates to 40,000 A and an illustration reproduced below depicts one of the smelting furnaces in operation with the bars and flexible droppers clearly shown.



All joints, with the exception of end bolted connections, are of the clamp type, the latter being cast in gunmetal. The insulation material used was "Ebony Sindanyo," matt finish, and all supporting steelwork and hangers were fully rust-proofed.

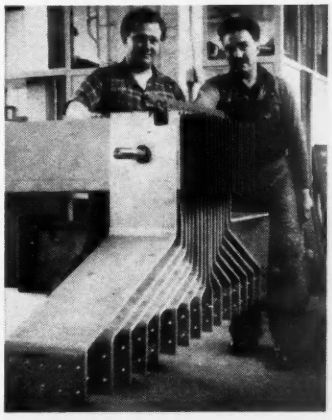
On completion at Barlow & Young's works, each part was numbered and set out in schedule form with full instructions and erection sequences which were sent to the clients before delivery.

Packing presented a problem. Some of the bars were 36 ft long and in order to avoid bending by mishandling, stringent precautions had to be taken. All necessary jointing materials, together with spare parts such as bolts, nuts, clamps, etc., were included in the shipment, and wire brushes were provided for the purpose of removing any oxide coating.

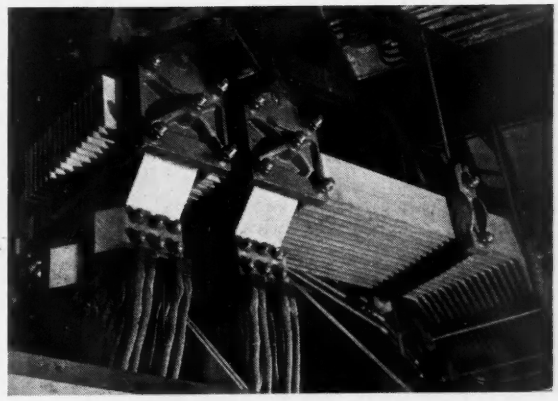
Barlow & Young, Ltd., who have carried out a very large number of heavy-current busbar installations in this country, were able to manufacture this equipment so that, from receipt of the order, the first furnace was in commission within six months.

Left: Rear view of furnace and flexible cables

Right: An idea of the size of the bars can be gained from this picture showing men engaged on assembling them



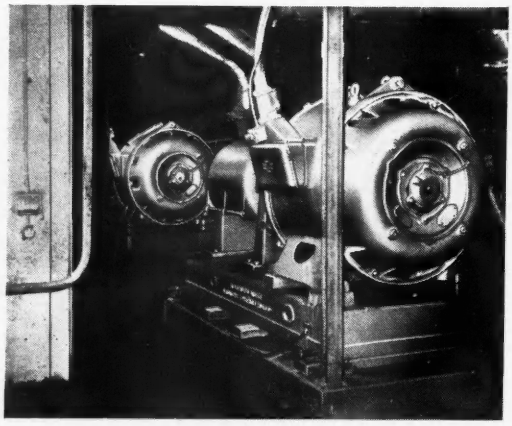
Below: Another view of busbars and cables showing a typical clamped joint with take-off to flexible droppers



INDUSTRIAL NEWS

Motors for Australian Power Station

When completed next year the Port Augusta power station of the Electricity Trust of South Australia, which is situated at the head of Spencers Gulf near the Leigh Creek coalfield, will have a total output of 180 MW, which will be transmitted to Adelaide, a distance of 200 miles, by 132kV overhead line. The six 175,000lb/hr boiler units (supplied by Riley Dodds Australia, Ltd.) will burn high-moisture sub-bituminous coal, the whole of the boiler house auxiliary motors being supplied by Australian Electrical Industries Pty., Ltd. These include forty-two motors totalling 7,800 h.p. manufactured by the Metropolitan-Vickers Electrical Co., Ltd.



Two of eighteen 250 h.p. Metropolitan-Vickers t.e.f.c. squirrel cage motors, direct-on-line started, driving coal pulverisers at Port Augusta power station

All these motors are totally-enclosed fan-cooled squirrel cage machines with direct-on-line starters; eighteen 250 h.p. motors drive coal pulverisers, twelve 200 h.p. motors drive 60,000 cu ft/hr induced draught fans, and twelve 75 h.p. motors drive forced draught fans. The 250 h.p. motors, because of the high inertia of the pulverisers, are designed to have a starting time of 90 seconds. The 200 h.p. and 75 h.p. fan motors are specially designed to drive through Vulcan-Sinclair hydraulic couplings, each motor being provided with two roller bearings, one of which limits the axial movement of the shaft to $\frac{5}{32}$in; the motor speed is 975 r.p.m. and the coupling enables the fan speed to be varied according to the volume of flue gas, which depends on the boiler load

Scottish Nuclear Power Course

The first nuclear power engineering course held in Scotland took place in the Royal Technical College, Glasgow, from 2nd to 4th July. The Industrial Group, U.K.A.E.A., and the C.E.A. co-operated in this venture and provided the speakers. Its purpose was to give senior executives in Scotland an opportunity to review the current developments and the forward problems of nuclear power engineering. The sessions were attended by representatives of Scottish electricity generation authorities, electrical contractors, power plant manufacturers, valve and piping manufacturers, shipbuilders, consulting and civil engineers, the Scottish Council, steelmakers, and a wide range of engineering concerns. The initial survey on "Principles of Nuclear Power" was given by Mr. C. E. Iliffe of the A.E.A. who also spoke on "Types of Nuclear Power Reactor." Mr. D. L. Linning (A.E.A.) covered "Heat Transfer in Nuclear Reactors," and "Nuclear Reactor Power Plant." Other papers were "Metallurgy of Nuclear Power Reactors," by Mr. A. B. McIntosh, "Operating Characteristics of Nuclear Power Reactors," and a film—"The First Report on Calder Hall," by Mr. J. Bowen, "The C.E.A. Nuclear Power Programme," and "Nuclear Power and System Planning," by Mr. R. H. Burdett, and "Nuclear Power Development Overseas," by Mr. J. C. Duckworth.

Coal Consumers' Councils

The annual reports of the Industrial and Domestic Coal Consumers' Councils for the year ended 30th June last have just been issued.

The Industrial Consumers' Council in its report, while accepting that the National Coal Board needed the additional revenue, deplores the necessity for the further increase of 8 per cent in pithead prices operating from 1st June. It states that its main concern in the past year has been that costly expedients have had to be resorted to to meet the rising demand for fuel and that pithead prices have risen by over 25 per cent in all. After making due allowance for all the difficulties it considers that the gap in indigenous fuel supplies could be narrowed if full advantage were taken of suitable available labour from overseas. Above all, it considers that the most positive way of relieving the present situation is for industry to make the maximum use of the facilities offered by the National Industrial Fuel Efficiency Service to secure an all round improvement in fuel usage. An appendix to the reports shows that consumption of coal in the electricity industry was 44.1 million tons in 1955-56, an increase of 3 million tons as compared with 1954-55 and 8.8 million tons as compared with 1952-53.

Multicore Solders in Australia

Mr. R. Arbib, managing director of Multicore Solders, Ltd., states that plans have been completed to manufacture Ersin Multicore 5-core solder in Australia. A freehold factory has been purchased at Alexandria, Sydney, and arrangements made for a complete manufacturing plant to be installed. Mr. J. A. Bull, managing director of Multicore Solders (Aust.), Pty., Ltd., is now in England conferring with Multicore executives. Mr. G. Edmends, who has been chief maintenance engineer at the Hemel Hempstead works, left on R.M.S. *Orontes* at the end of June, accompanied by his wife and family. On his arrival in Sydney he will be appointed works manager of the Australian factory. The sales offices will be at 43-51, Nelson Street, Annandale, Sydney, and Messrs. R. A. Archer and J. J. Coyle will be in charge of technical sales under the direction of Mr. Bull.

George Ellison Museum

Readers may recall that in May last George Ellison, Ltd., which is celebrating its golden jubilee this year, offered to give modern gear in free exchange for certain equipment in an endeavour to obtain good specimens of its early equipment for inclusion in its museum. The company informs us that since the scheme was launched, several manufacturers have brought to light the existence of early Ellison gear still in use. One example is shown in the accompanying picture of a rotor

Ellison oil-immersed rotor starter that has been controlling a 32 h.p. motor in the Dunlop Rubber Co.'s Manchester factory since 1913

starter in the Manchester factory of the Dunlop Rubber Co., which has been controlling a 32h.p. motor since 1913. Those interested in the company's scheme of exchange can obtain details from any of its branches.

Soviet Trade Delegation

Mr. V. A. Malyshev, accompanied by members of the Russian Trade Mission, called on the President of the Board of Trade, Mr. Peter Thorneycroft, on 11th July and discussed with him the purchasing programme which was submitted to the Government during the visit of Messrs. Bulganin and Khruschev in April. Mr. Malyshev and the members of the Delegation will visit, in small groups, firms in various parts of the country; full details of their programme are being worked out in consultation with the Board of Trade and industry.

Prices and Exports

Nearly forty representatives of works joint committees of the Brush Group factories met directors of the Brush Group, Ltd., in London, on 6th July to discuss the company's annual report and accounts for 1955. Mr. G. C. R. Eley, chairman of the company, presided and was supported by Mr. Miles Beevor and Mr. Ian T. Morrow, joint managing directors of the Group. Mr. Eley told the meeting that the most important lessons to be learned from the accounts were that in the face of narrow profit margins sales must be increased both at home and abroad, and costs of the Group's products must be reduced by every means available. It was vital for the continuance of the prosperity of the Group, and of this country as a whole, that all concerned should be continually on the lookout for ways of saving money and of reducing costs. The alternative was to be priced out of world markets by competitors abroad and perhaps at home. The works committee representatives were afterwards entertained to luncheon by the directors of the parent company.

Kent County Show

At the Kent County Agricultural Show held last week at Mote Park, Maidstone, one of the stands which attracted a large number of visitors was that of the South Eastern Electricity Board. An impressive display of domestic electrical appliances included a special water-heating section where various types of storage and immersion heaters were shown. Continuous demonstrations were given in three kitchens featuring home laundry appliances, food preparation equipment and electric cookers. In the last-named kitchen particular attention was devoted to the English Electric raised oven automatic cooker.

Among the various farming processes covered was a display of Lister sheep-shearing machinery and horse clippers, and for the pig breeders there was a selection of dull-emitter heaters, including those of P. & R. Electrical ("Elstein") and the British Thomson-Houston Co. ("Pyrobar"). Milking, milk cooling and sterilising equipment for the dairy farm was represented by a Prestcold CWH series milk cooler, an improved "Electrobloc 27" self-contained steriliser (J. W. Woolley & Co.) and the recently introduced Gascoigne electronic system for all milking machines. A well-set-out G.E.C. exhibit on the stand demonstrated the company's platform and silo grain drying equipment.

The Opancol "Quicklift" portable special type grain elevator, shown for the first time by the Board, consists basically of a 9ft metal tube to which is fitted at one end a ½ h.p. single-phase electric motor. It can be quite comfortably operated by one man. Extra extension tubes in 4 and 6ft lengths are available. Other equipment on view included a 4cwt pig food boiler, soil heating and sterilising equipment, Bentalls' self-emptying food mixer for the pig producer and poultry keeper and the "Wizard" hammer mill. A small section of the Board's stand was allocated to the Electrical Association for Women and this was staffed by members of the Maidstone Branch. The whole exhibit was designed and erected by the Board's own staff.

Power Station Fatality

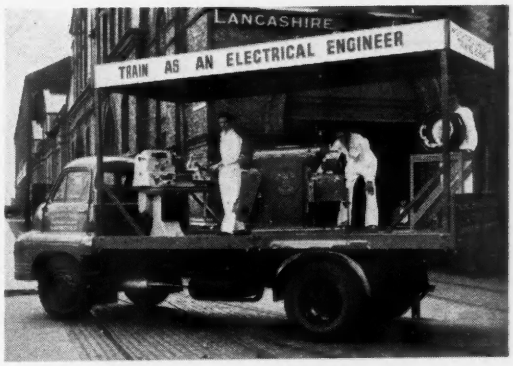
One man was killed and three others injured, one seriously, last week when some 40 tons of scaffolding collapsed inside the new 340ft high concrete chimney at Kirkstall power station, Leeds.

Baird Memorial

John Logie Baird, Scottish born inventor of television and former student of the Royal Technical College, Glasgow, was remembered by a large gathering of trade and personal friends on 12th July when a memorial plaque was unveiled in the College by the Postmaster General, Dr. Charles Hill. Professor Bruce outlined the technical impact of Baird's work. Mr. J. Robertson, past president of the R.W.F., recalled personal recollections of the early experimental work and the impact of Baird on the men of his generation, and Dr. Hill also paid tribute. Among those present were the inventor's widow, his sister and his son, Mr. Malcolm Baird.

Carnival Display

The accompanying picture shows an exhibit staged by the Trafford Park Works of Lancashire Dynamo & Crypto, Ltd., for inclusion in the Stretford Carnival. The slogan, "Train as an Electrical Engineer," is the title of the apprenticeship brochure which has just been produced on behalf of the Lancashire Dynamo Group.



The entry of Lancashire Dynamo & Crypto, Ltd., in the Stretford Carnival

Transformers for T.V.A.

Orders for three large transformers to a total value of over £200,000 have been placed with the English Electric Co., Ltd., by the Tennessee Valley Authority. Two of the transformers, each rated at 17.1 kV, 60 c/s, 170 MVA, are for the Johnsonville station and one, rated at 57/13 kV, 60 c/s, 50 MVA, for the Lenoir station.

Electro-Chemical Plant Factory

With the opening of the Electro-Chemical Engineering Co.'s new factory at Sheerwater, near Woking, Surrey, the headquarters and offices of the company are now at this address instead of at Weybridge as formerly.

At the new factory the assembly and mechanical testing of "Efco-Udylite" automatic machines is carried out, as well as the mixing and packaging of the range of chemicals used in the various "Efco-Udylite" processes. In the laboratories the routine analysis of customers' solutions is undertaken and new plating processes tried out and demonstrated. The initial development of the three-acre factory site is over a frontage of two-thirds of the area.

The factory consists of six bays 25ft in width, five of them having a length of 66ft and a height to the underside of the truss of 16ft. The sixth has a length of 88ft and a height to the underside of the truss of 23ft, this bay having a 3-ton overhead crane. Three bays are in use for chemical products and three for engineering. A building 20ft in width is connected to the main factory and runs the full 210ft width of the six bays; this contains the demonstration plating shop, analytical and development laboratories and offices for chemists. To the north is a separate office block with two floors

which is connected to the works by a covered way.

The floor area of the factory is 21,000 sq ft and that of the office block 7,000 sq ft. The buildings have been laid out in such a manner that they can be extended without interruption of the existing processes. Provision has also been made for the extension of the office block and roads and services have been laid out with these future extensions in view.

The products of the company include fully automatic electroplating, anodising and pickling machines and semi-automatic plating machines. Under an agreement with the Udylite Corporation of Detroit, the company supplies Udylite bright plating processes comprising bright nickel, bright zinc and bright cadmium. The company also manufactures under licence di-phase cleaning equipment and cleaning processes, besides automatic degreasing equipment.

Next Week's Events

The guest speaker at next Wednesday's luncheon of the Batti-Wallahs' Society (Connaught Rooms, 12.30 for 12.55 p.m.), will be Mr. C. I. Coughtrey, J.P.

London graduates and students of the Institution of Electrical Engineers are reminded of the summer outing on Saturday next week (28th July) when the College of Aeronautics, Cranfield, and Woburn Abbey, Bedfordshire, will be visited.

Expelled Electrician's New Appointment

It is reported that Mr. H. B. Harkness, the electrician who recently brought an action against the Electrical Trades Union claiming that he had been wrongly excluded from membership and obtained judgment on terms agreed, has now resigned from the Union. This follows his appointment to the staff of the Workington Iron & Steel Co., as a shift fuel controller.

Diesel Engine Films

Last week a preview of two films recently produced on behalf of R. A. Lister & Co., Ltd., was given in London. The first, entitled "Railway Marshalling—the Modern Way," was made with the co-operation of British Railways and shows the various stages in the construction of a modern diesel-powered shunting engine as well as depicting up-to-date marshalling yard technique. It was pointed out during the film that the time taken to build a diesel-electric locomotive is about two-thirds of that of its steam equivalent. The type of engine used in these locomotives is the Lister-Blackstone ERT 6, a 4-stroke engine giving 350 b.h.p. at 750 r.p.m. Thirty have been built during the past two years and are operating in marshalling yards in this country. Half of them incorporate G.E.C. electrical transmission while the B.T.H. Co. provided equipment for the remainder. Recently the G.E.C. has placed an order with R. A. Lister & Co. for a further forty-five Type ERT 6 diesel engines for shunting locomotives to be assembled at Darlington.

In the second film, "Diesels in Industry," typical installations seen include those at London Airport, the power house at the Bath & West Show, Deal sewerage works, Hereford telephone exchange and Dursley gasworks.

Both films were produced by Technical & Scientific Films, Ltd., in association with the Film Producers Guild in 16mm Kodachrome colour with a running time of 24 and 32 minutes respectively.

Cookers for U.S.A. Air Force

The contract for supplying 1,400 electric cookers to be installed in the homes of members of the U.S.A. Air Force now stationed in this country has been awarded to Falco Electrical Appliances, Ltd., a subsidiary of Allied Ironfounders, Ltd. The cookers chosen are the Falco-Royal. Deliveries will commence shortly to the selected areas.

Great Yorkshire Show

The Yorkshire and North Eastern Electricity Boards again co-operated at the Great Yorkshire Show where their stand occupied a site of over 10,000 sq ft. On the domestic section a complete selection of appliances was shown and continuous cooking and rotary ironing demonstrations were given. Dairy and poultry appliances, aids to pig keeping and a demonstration of potato sprouting under artificial illumination were also shown. Several different makes and types of pumps were shown working near the horticultural section in which there was an 8-bay Dutch lighthouse and a small lean-to greenhouse filled with various machines and appliances for the commercial and amateur grower, including demonstrations of artificial illumination for tomato and cucumber seedlings and of soil warming. In the centre of the stand various milling and mixing machines were shown. There was also equipment for grain drying and the cold blow-hot blow method of grass drying, and a half-scale model of a barn hay drying floor. Machines for cleaning, elevating and conveying grain were also shown in operation.

Instruments, Electronics and Automation

At a meeting held in London last week plans were outlined for an Instruments, Electronics and Automation Exhibition which is to be staged at Olympia, London, from 7th to 17th May next year.

It is proposed to expand the scope of the former British Instrument Industries Exhibition, previously held in 1951, 1953 and 1955, and it is believed that in its new form it will be the first to embrace the whole of the electronics industry.

The exhibition is being promoted by the following five trade associations: The British Electrical and Allied Manufacturers' Association; the British Industrial Measuring and Control Apparatus Manufacturers' Association; the British Lampblown Scientific Glassware Manufacturers' Association; the Drawing Office Materials Manufacturers' and Dealers Association; and the Scientific Instrument Manufacturers' Association of Great Britain. It is being arranged on their behalf by a newly formed exhibition organisation, Industrial Exhibitions, Ltd., headed by Mr. T. E. Rees, until recently deputy to Mr. Kenneth Horne, managing director of British Industries Fair, Ltd.

Complementary to the exhibition will be a continuous programme of conferences, lectures and meetings.

Firth of Clyde Telephone Link

The Postmaster-General has announced that a new service will be introduced about the end of this year which will provide radio-telephone communication between suitably equipped ships in the Firth of Clyde and telephone subscribers in the United Kingdom. The service is expected to be of particular value for ships undergoing trials. The shore station will be situated in the Isle of Bute, and work on the site has already commenced. The service will operate on v.h.f. and will use frequency modulated equipment; the frequencies to be used will probably be standardised internationally for radio services of this kind.

Annual Holidays

The works of Transformers (Watford), Ltd., will be closed for the annual holiday from 6th to 20th August inclusive.

Trade Announcements

Mr. J. G. Burns has been appointed to represent **Ashley Accessories, Ltd.**, and its associate, **Astral Switchgear, Ltd.**, on the North-East Coast. He will be based at Newcastle-on-Tyne.

Lumenated Ceilings, Ltd., has acquired larger Scottish sales offices at 10, Bothwell Street, Glasgow, C.2 (telephone: Glasgow Central 6571-2). The Scottish sales staff were previously housed in the head office of Thermotank, Ltd., the parent company.

Atkins, Robertson & Whiteford, Ltd., of Glasgow and London, have moved into a larger new factory in the Thornliebank Industrial Estate, Glasgow (telephone: Giffnock 1031/2).

Work has commenced on a new Gloucester factory for **Permali, Ltd.** It occupies a 6½-acre site opposite the existing premises in Bristol Road and should be completed by the end of next year.

Aluminium Conductor Cable Jointing

NEW FLUX SIMPLIFIES PROCEDURE

THE development of a new solder flux, "Junal 5", which overcomes the criticisms that have been levelled at previous soft-soldering techniques for the jointing of stranded aluminium conductors, is announced by Johnson & Phillips, Ltd., of Charlton.

Aluminium conductor cables are being increasingly used by leading concerns because of the economies which can be obtained, but their general use has been somewhat retarded by the tediousness of jointing. The use of "Junal 5" is claimed to eliminate the disadvantages hitherto encountered and enable completely solid joints to be produced without a high degree of skill. Certainly the claim was borne out at a demonstration which we recently attended. The disadvantages of the existing techniques are: the necessity to step back the ends of conductors and splay out inner wires before soldering, and to pre-tin conductors before fitting lugs and ferrules; the poor penetration of solder into strand interstices; the necessity to control the solder pot temperature to avoid overheating of the flux; and the objectionable smell from the flux fumes.

These shortcomings in the organic types of flux for aluminium are very real when used on cables in the field, but they have had to be accepted in compliance with the insistence of engineers on soldering temperatures no higher than those absolutely necessary for copper, about 250 deg C. In practice, with copper conductors this temperature is frequently exceeded by a very large margin and as a result some jointers experience difficulty when using aluminium conductors and an organic flux because their metal pots are so hot as to char the flux and render it useless.

It is known that Continental practice for many years with aluminium conductors has been to use much higher soldering temperatures than with copper, employing gas torch heating of the joint and other rather unattractive methods. These higher temperatures, however, result in better wetting of the strand by solder and give increased area of solder penetration.

From these considerations, experiments led to the evolution of "Junal 5", a reactive flux which has only one basic requirement in that it must be heated to 350 deg C for a few seconds to operate. Unlike an organic flux, it cannot be harmed by overheating; in fact, its action improves as the temperature is increased.

The flux is supplied in paste form and by its use joints into ferrules and end terminations can be made by a procedure almost identical with that employed for copper conductors, the procedure for a straight-through joint being as follows:—

(a) After trimming back insulation in the normal way the squared-off ends of the conductors are arranged to butt, leaving an $\frac{1}{8}$in gap between them. They must not touch (see Fig. 1).

(b) For the ferrule length the conductors are lightly smeared with "Junal 5". A weak-back ferrule is applied and tightened and a little flux is smeared along the slot and in the gap between the conductors.

(c) A pot of TCZ solder is heated to at least 400 deg C.

(d) Using a ladle, solder is gently poured on the sides of the ferrule until the flux is fully molten and frothing. On conductors of 0.4 sq in this usually requires two applications of solder. Solder should not enter the ferrule at this stage if it can be avoided (see Fig. 2).

(e) Solder at 400 deg C or above is then ladled over and into the joint to heat it as quickly as possible. The ladling should be repeated four or five times until copious white fumes with little odour are given off, and heating must be continued until these are clearly seen.

(f) The ferrule can then be tightened further if necessary and the joint filled and completed in the normal manner using TCZ solder.

End sockets and other terminations are treated in a manner similar to copper conductors, the aluminium strand being smeared with flux, particularly on the butt end prior to its introduction into the socket. No attempt should be made to tin the aluminium strand before its introduction into a socket or ferrule because the full advantages of the flux are only obtained when it is heated in a semi-confined space. When heated on freely exposed aluminium surfaces full reduction is not always obtained and a crust of oxide may form.

The temperature requirement of 350 deg C to tin the strand inevitably increases the risk of charring strand insulation, but in practice it is found that any charring that may occur is confined to the innermost paper, and

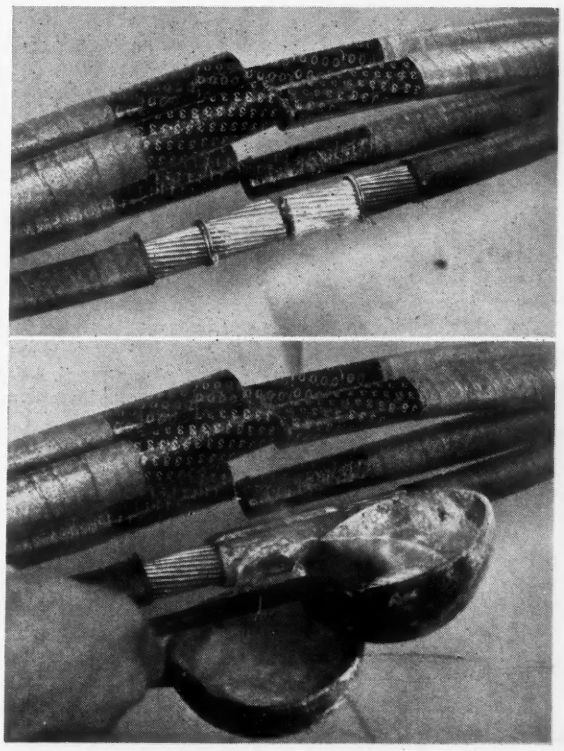


Fig. 1. (top)—*Butt ends of the conductor lightly smeared with flux prior to fitting of the ferrule. Note the* $\frac{1}{8}$ *in. gap which must be left*
Fig. 2.—TCZ solder at 400 deg. C. being poured on the sides of the ferrule to make the flux fully molten

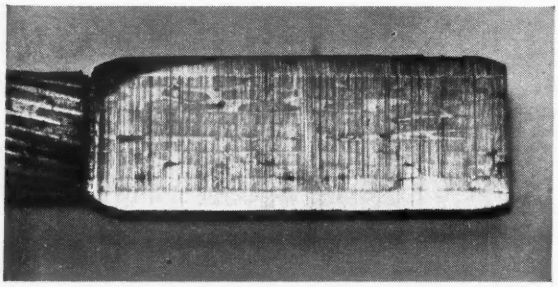


Fig. 3.—Sectional view of a joint showing the excellent degree of penetration achieved, this usually going some way beyond the end of the actual ferrule

that only over a portion within about 1½in from the end of the joint ferrule. By trimming back insulation for a distance of 1½in to 2in all risk of damage by overheating is avoided.

Comparative tests have already shown that joints made with "Junal 5" are more solidly filled and are at least equal to those made with the best organic flux in respect of conductivity and mechanical strength. In short-term tests under damp conditions they have shown themselves to be more reliable than those made with organic fluxes but, like all soft-soldered joints on aluminium, they should be protected against moisture. Long-term tests which will take many months to complete are in hand, but the results to date are sufficiently encouraging to justify a high degree of optimism.

The flux is to be marketed in metal tubes, enabling the desired quantity to be squeezed out as required.

THE "CABMA REGISTER"

THE 1956-57 edition of the "CABMA Register of British Products and Canadian Distributors" has been published. In a foreword to the fourth edition, Sir William Rootes, G.B.E., chairman of the Dollar Export Council, says: "With the ever-growing interest in British goods amongst Canadian buyers, an up-to-date and comprehensive directory of what our manufacturers can supply is a vital part of our merchandising equipment. This is what the CABMA Register provides."

The object of the Canadian Association of British Manufacturers is to develop an even greater market for British goods in Canada and so stimulate the two-way flow of trade between the two countries.

The new edition of the Register brings up to date all the information contained in previous editions. The Buyers' Guide lists alphabetically some 4,000 British products available to the Canadian market, with their suppliers given under each heading. The French equivalents of these headings are set out in alphabetical order in a separate glossary. A directory of over 4,500 British firms gives details of their distribution arrangements in Canada and further information about some of these firms and the products they supply is given in another section. Proprietary names and trade marks are given in special sections which enable the Canadian buyer to identify products and their sources of supply. The six sections are divided for easy reference by index cards with reinforced tabs and containing instructions in French as well as English. Special introductory messages are included from the chairman of the Dollar-Sterling Trade Council, Mr. James S. Duncan, C.M.G., and the president of CABMA, Mr. Lewis J-B. Forbes, in Canada.

The CABMA Register is the Canadian buyer's standard work of reference and the degree of completeness and efficiency attained by this edition has once again been made possible by the co-operation of the following sponsoring organisations: the Dollar-Sterling Trade Council in Canada and in the United Kingdom, the Dollar Exports Council, the Federation of British Industries, the National Union of Manufacturers and the Scottish Council (Development and Industry).

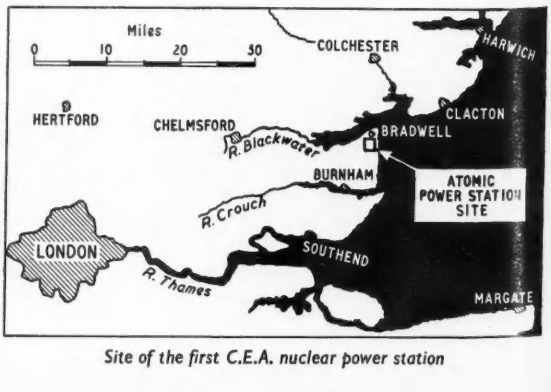
The Register is published for CABMA jointly by Kelly's Directories, Ltd., and Iliffe & Sons, Ltd., at 42s net (44s by post). It consists of 732 pages bound in full cloth.

Nuclear Power Station

C.E.A. Receives Minister's Consent to Bradwell Scheme

THE Central Electricity Authority has received the consent of the Minister of Fuel and Power to the establishment of the proposed nuclear power station at Bradwell in Essex. The Authority's application to build this station was the subject in April of a local inquiry lasting 4½ days at Bradwell and Maldon, Essex. The Minister's consent is for the erection of a nuclear power station containing turbo-alternator sets having an aggregate electrical output of about 200,000 kW; two carbon dioxide gas cooled, graphite moderated reactors together with the necessary heat transfer and exchanging plant; and the necessary buildings and civil engineering works. This will be the first large nuclear power station designed specifically for public electricity supply and the first of the 12 stations envisaged in the Government White Paper of February, 1955, on the nuclear power programme.

The detailed design and construction of the station are open to competitive tender and the proposals of the four industrial groups of manufacturers who are entering this new field are due in October. The necessary preliminary works, including the provision of road access, are being put in hand at once, so that there will be no delay in work on the site. It is hoped that the successful tenderer will be able to make a start early next year. In view of the fears that have been expressed about the possible effects of the operation of the power station upon the local oyster industry, the Authority intends to keep the problems of the industry under constant review. To this end it has undertaken to co-operate with the Fisheries Department of the Ministry of Agriculture, Fisheries and Food in a continuing study of conditions existing in the Blackwater Estuary.



Site of the first C.E.A. nuclear power station

Electrical Fires

Responsibility for Damage to Property

By C. F. MAYSON, A.M.I.E.E.

THE purpose of this article is to consider the legal liability of those who may be held responsible for fires the origins of which can be traced to electrical causes. Much has been done in recent years to reduce the incidence of such fires, but they do occur from time to time and many of them are started, in the eyes of the law at least, by the inevitable "short-circuit." In these circumstances it is only right that those concerned with electrical installations should understand the extent and limits of their responsibility.

It has long been a rule of English law that a man must "keep in his fire at his peril." This means that if a fire, started on his premises, spreads to his neighbour's property he will be responsible for the resulting damage. The rule was modified by the Fires Prevention (Metropolis) Act of 1774 to the extent that if a fire begins accidentally there is no liability. "Accidentally" has been defined as meaning that the fire must have begun by mere chance or that its origin cannot be traced to any definite cause. If, however, the cause is known or reasonable steps have not been taken to prevent the fire spreading, then it is open to the person who has suffered damage to sue the occupier (i.e., the owner or tenant in possession) of the premises from which the fire emanated, and there is some choice as to the precise action to be taken.

Occupier's Liability

The occupier may be held responsible in negligence, in nuisance or under the rule in *Rylands* v. *Fletcher*. Negligence is, of course, failure to take such care to confine the fire to his own premises that damage is caused to those of his neighbour. Nuisance is allowing his premises to be in such a dangerous condition that damage is caused to the occupier's neighbours or to the public. The rule in *Rylands* v. *Fletcher* is to the effect that if any person has or keeps on land which he occupies anything which is likely to do damage if it escapes, he will be answerable for all the natural consequences of its escape. In all these cases it is the occupier himself who is primarily liable, save that in the case of an "escape" under the rule he will be able to avoid liability if he can show that it was due to the act of a trespasser or someone over whom he had no control. As to whether he can, in any circumstances, obtain indemnity (apart from insurance) will now be considered, for it may well be that, in the case of an electrical fire, the contractor will have to provide it.

In *Collingwood* v. *Home and Colonial Stores** a fire started in the defendants' premises, allegedly due to a defect in the electrical wiring, and spread to those of the plaintiff. Although it seemed fairly certain that the wiring was defective (it had been done in capping and casing and with twin twisted flexible), the Court of Appeal held that there was not sufficient evidence of negligence to hold the defendants liable. Even assuming that the wiring was so defective as to be a danger within the rule in *Rylands* v. *Fletcher*, it was decided that the rule did not apply to the use of electricity in ordinary premises, as such use is part of the ordinary use of property. (This is in contradistinction to the transmission or distribution of electrical energy in underground mains, for a fault causing damage to adjacent water or gas mains is an "escape" within the rule.)

But in *Spicer* v. *Smee*†, where a fire which started in a Thames-side wooden bungalow spread to and totally destroyed an adjacent bungalow, the owner was held liable in nuisance in that she had permitted a defective installation to remain dangerous. It was proved conclusively that the work had been done negligently in the first place, for it was shown that the sheathing and insulation of the cables had been stripped back so far that bare conductors were in contact with damp wood.

The Contractor's Position

It is well known that where an occupier has taken steps to remove a danger, for which he may be liable in negligence, by employing a competent contractor to do the work and is, nevertheless, held liable, he may claim indemnity from the contractor. Thus, in the *Collingwood* case, had negligence been found and had the defendants shown that they had taken steps to remove the defects in the installation by employing an ostensibly qualified contractor, he and not they would have been responsible. In *Spicer* v. *Smee*, however, it was held that it was the duty of the defendant, as owner, to ensure that her bungalow was not so dangerous as to become a nuisance; negligence was not alleged.

In nuisance an owner or occupier is always liable for the acts of his agents and indemnity cannot be claimed as it can in negligence. Thus, the contractors who were originally responsible for the defect which caused the fire escaped liability. The owner herself might, of course, have sued the contractors for negligence in carrying out the contract. But as the work had been done more than six years previously, her action was barred by the Limitation Act.

A recent case, though not concerned with electrical defects, is apt to illustrate the secondary liability in negligence of a contractor. In *Balfour* v. *Barty-King*‡ the defendant had employed a firm of builders to de-freeze water pipes in his house during a cold spell. Two of the builders' men went up into the roof and began using a blow-lamp on an unlagged pipe. In so doing some adjacent lagging caught fire and very quickly the whole roof was alight, the fire spreading to the next door house which belonged to the plaintiff. He claimed £3,140 from the defendant and the defendant claimed £5,875 for the damage to his own house from the builders, whom he had brought in as a third party in the action. It was held that the defendant was primarily liable to the plaintiff both in negligence and under the rule in *Rylands* v. *Fletcher*, for a blow-lamp used in that manner was something likely to do damage. Judgment was given for the sum claimed. It was further held that the defendant was entitled to indemnity in this sum against the builders, who were themselves held liable in negligence to the defendant for the sum claimed by him. In the result the use of that blow-lamp cost the builders over £9,000 in damages.

* (1936) 3 All England Reports 200.

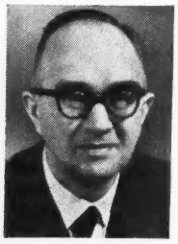
† (1946) 1 All England Reports 489.

‡ (1956) 1 Weekly Law Reports 779.

I.E.E. ELECTIONS

New President, Council Members and Section Officers

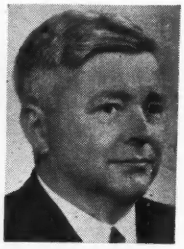
THE President of the Institution of Electrical Engineers for the ensuing year is Sir Gordon Radley, K.C.B., C.B.E., Ph.D., (Eng.), Director General of the Post Office.



Sir Gordon Radley

Sir Gordon received his education at Leeds Modern School and Faraday House, and his practical training with Bruce Peebles & Co., Ltd. He entered the G.P.O. by open competition as assistant engineer in 1922, and for the greater part of his career he has been associated with the Research and Engineering Department. His early work was in connection with interference between power and communication circuits. From 1944 to 1949 he was controller of research, from 1949 to 1951 Deputy Engineer-in-Chief, and from 1951 to 1954 Engineer-in-Chief. He was appointed Deputy Director General in 1954 and in the following year became Director General. Sir Gordon is a past-chairman of the Measurements Section of the I.E.E. (1944-45) and has been a vice-president of the Institution since 1951. He is chairman or a member of various boards and committees and has frequently represented Great Britain at meetings of the C.C.I.F. (International Advisory Committee on Long-Distance Telephony). Last year he received (with Mr. Mervin Kelly, president of the Bell Telephone Laboratories, New York), the international Christopher Columbus communications prize for work on the transatlantic telephone project.

Mr. S. E. Goodall



Mr. G. S. C. Lucas

To fill the two vacancies of vice-presidents, Mr. S. E. Goodall, M.Sc.(Eng.) (chief engineer, W. T. Henley's Telegraph Works Co., Ltd.), and Mr. G. S. C. Lucas, O.B.E. (director and chief electrical engineer, British Thomson-Houston Co., Ltd.), have been elected. Viscount Falmouth (member of the S.E.E.B.), has been re-elected hon. treasurer.

The vacancies on the Council have been filled by the following: Mr. J. A. Broughall, B.Sc.(Eng.) (electrical engineer (development), British Transport Commission), Mr. B. Donkin, B.A., A.M.I.C.E., M.Cons.E. (partner, Kennedy & Donkin), Mr. A. H. Mumford, O.B.E., B.Sc.(Eng.) (Deputy-Engineer-in-Chief, G.P.O.), Mr. D. P. Sayers, B.Sc. (Hons.), M.I.Mech.E., M.Amer.I.E.E. (deputy chairman, Midlands Electricity Board), Mr. H. Watson-Jones, M.Eng., M.I.Mech.E., M.I.Min.E. (chief engineer, Durham Division, National Coal Board) and Mr. H. West, A.M.C.T., M.I.Mech.E. (director and chief electrical engineer, Metropolitan-Vickers Electrical Co., Ltd.). Associate member: Mr. E. M. Hickin (head of the radio trunk group, Research Laboratories, General Electric, Co., Ltd.).

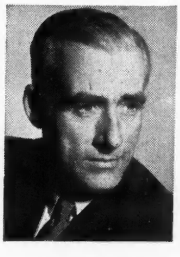
The new officers and committee members of the various Sections are as follows:—

Measurement and Control: Chairman, Mr. D. Taylor, M.Sc., Ph.D., F.Inst.P.; vice-chairman, Prof. C. Holt Smith, C.B.E., M.Sc.; members, Messrs. W. S. Elliott, M.A., W. C. Lister, B.Sc., R. S. Medlock, B.Sc., M. V. Wilkes, M.A., Ph.D., and R. H. Tizard, B.A.

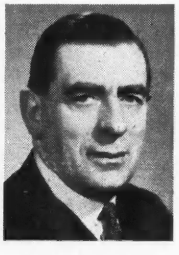
Radio and Telecommunication: Chairman, Mr. R. C. G. Williams, Ph.D., B.Sc.(Eng.); vice-chairman, Mr. G. Millington, M.A., B.Sc.; members, Messrs. W. J. Bray, B.Sc.(Eng.), H. A. M. Clark, B.Sc.(Eng.), C. W. Earp, B.A., and V. J. Francis, B.Sc.

Supply: Chairman, Mr. P. J. Ryle, B.Sc. (Eng.); vice-chairmen, Prof. M. G. Say, Ph.D., M.Sc., and Mr. J. R. Mortlock, Ph.D., B.Sc. (Eng.); members, Messrs. F. H. S. Brown, B.Sc., P. M. Hollingsworth, M.Eng., J. E. L. Robinson, M.Sc., E. P. G. Thornton, and F. C. Walmsley.

Mr. J. A. Broughall



Mr. B. Donkin

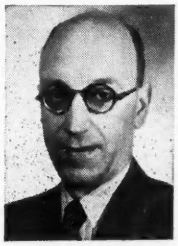


Mr. A. H. Mumford

Utilization: Chairman, Mr. H. J. Gibson, B.Sc.; vice-chairman, Mr. O. W. Humphreys, B.Sc., F.Inst.P.; members, Messrs. B. Adkins, M.A., H. H. C. Barton, B.A., J. B. Lancaster, B.Sc., and P. McKearney.

Mr. D. P. Sayers

Mr. H. Watson-Jones



Mr. H. West

Mr. E. M. Hickin

Inflation and Prices

THE Association of British Chambers of Commerce, the British Employers' Confederation, the Federation of British Industries and the National Union of Manufacturers have united in recommending a policy for defeating inflation. A statement issued says that while the urgent need remains for resolute action in reducing public spending, the Government's measures to stop inflationary pressure at its source, slow at first, appear now to be having some effect. The Boards of the nationalised industries have announced measures to steady the prices of their products for substantial periods. This is the time when private industry, in its own as well as the national interest, should do what is in its power to match these actions.

General guarantees of price freezing are not possible when costs of materials may rise. Quotations for many manufactured products, unlike those for coal, power and transport, are made for deliveries months or years ahead. Nevertheless, the above-mentioned bodies advocate and will support a policy of great restraint in a united effort to bring inflation to an end. Price restraint will not succeed unless the breathing space which it gives is used to bring down costs. The months immediately ahead will therefore have to be devoted with renewed vigour to the pursuit of higher productivity and administrative economies.

PERSONAL AND SOCIAL

News of Men and Women in the Industry

The English Electric Co., Ltd., announces that **Sir George H. Nelson,** Bt., chairman and managing director, has relinquished the position of managing director in order to devote the whole of his time to the duties of executive chairman of the company. The board has appointed **Mr. H. G. Nelson,** M.I.C.E., M.I.Mech.E., M.I.E.E., the deputy managing director, to be managing director of the company as from 1st July.

Mr. Nelson joined Sir George as deputy managing director in 1949. He is an honours graduate in Mechanical Science at Cambridge and was an Exhibitioner of King's College. Subsequently he had experience in France, Germany and Switzerland before taking up an executive position with the English Electric Co. From 1942 to 1949 Mr. Nelson was managing director of D. Napier & Son, Ltd., joining the board, of which he is still a member, when the English Electric Co acquired control of that company. In 1943 he became a director of the English Electric Co. He was appointed a director of the Marconi companies in 1949, and was responsible for the reorganisation of those companies upon their joining the English Electrical group, and he is a director of the Vulcan Foundry, Ltd., which joined the group last year. He has also been actively concerned in and responsible for the development of English Electrics aviation activities and many other major expansions in the wide field of engineering now covered by the company.

Mr. H. G. Nelson

Mr. R. V. Ely, M.I.E.E., M.I.Mech.E., has been appointed group research director by Lancashire Dynamo Holdings, Ltd., and will, as a consequence, relinquish his position as managing director of Foster Transformers, Ltd., and Foster Electrical Supplies, Ltd. He will, however, remain on the boards of both these companies with special responsibilities.

Mr. M. H. Hammill, B.Sc.(Eng.), A.M.I.Mech.E., Foster Transformers, Ltd., will be in executive charge of the company, and **Mr. L. G. Gunnell,** at present sales director of Foster Electrical Supplies, Ltd., will act in a similar capacity in that company.

Mr. J. Wilkie, manager of the Stationary and Traction Battery Sales Department of Chloride Batteries, Ltd., retired at the end of June. He has received a set of electrical workshop tools and a pair of binoculars from his colleagues at the Exide Works, Manchester. The presentation was made by Mr. C. Pritchett, director and chief engineer. Mr. Wilkie had been with the company for more than thirty years.

Mr. H. W. G. Hignett has been appointed assistant managing director of Henry Wiggin & Co., Ltd. Mr. Hignett, who is a director of the company, was responsible for technical (metallurgical) control and development in all Wiggin plants. He was previously superintendent of the Mond Nickel Co.'s Birmingham research laboratory.

Following the deaths of Mr. A. V. Heyes and Mr. B. E. Jones, directors of Heyes & Co., Ltd., the company announces the appointment as directors of **Mrs. M. H. Redmond** (governing) and **Mr. R. S. Redmond,** T.D. **Mr. Norman F. Brand,** A.M.I.E.E. and **Mr. W. Talbot,** both of whom have been with the company for over twenty years, are in charge of production and technical aspects of the business. The company continues to be represented from its London offices at 11, John St., W.C.1, **Mr. R. A. Brandley** being the southern counties sales manager. Mr. Brandley, who joined the company last year, was formerly sales engineer with Smart & Browns (Engineers), Ltd.

Mr. A. O. Williams, M.B.E., L.I.O.B., A.B.I.C.C., A.R.San.I., whose article on "Portable Tools and Building" appears in this issue, was educated at Guildford Technical College. He served his apprenticeship as carpenter and joiner and gained experience as trade and general foreman with several well-known Surrey building firms and with Saunders Shipyard. During the war he served with the Grenadier Guards, and was commissioned in the Buffs in 1941. He was demobolised in 1946 with the rank of major and awarded the M.B.E. for work with weapon training establishments. Since the war he has instructed in the Building Trades Department of the Brixton School of Building and has been closely associated with the building industry in the development of craft courses and the instruction of students in the use of powered hand tools. Mr. Williams has made several television appearances and been associated with the making of films of powered hand tools for the building industry.

Mr. A. O. Williams

Mr. N. R. Wheldon has been appointed district manager for Scotland for the Electric Construction Co., Ltd., which has opened district offices for Scotland at 8, Woodlands Terrace, Glasgow, C.3 (telephone: Douglas 1962). Mr. Wheldon served his apprenticeship with the Brush Electrical Engineering Co., Ltd., after which he spent eight years with the Lancashire Dynamo group. This was followed by three and a half years with G. P. Dennis, Ltd. Mr. Wheldon will be assisted by Mr. N. C. J. Badley.

Mr. N. R. Wheldon

Sir Giles Guthrie, Bart., and **Mr. G. W. Parker** have joined the board of Radio Rentals, Ltd.

Mr. D. G. Smee, M.B.E., Associate I.E.E., has been appointed manager of the Broadcasting Division of Marconi's Wireless Telegraph Co., Ltd., with effect from 1st August in succession to **Lt.-Col. H. A. Lewis,** M.B.E., T.D., B.Sc. (Eng.), M.I.E.E., who is leaving to take up another appointment.

Mr. D. G. Smee

Mr. Smee first joined Marconi's in 1933 and was for some time employed in the research laboratories. He was engaged on war service from 1940 to 1946, first in Royal Signals and then in R.E.M.E., and rose to the rank of major. He was awarded the M.B.E. in 1945 for his outstanding work in the Middle East and Italian theatres of war, where he was responsible technically and administratively for the maintenance and repair organisation of Army telecommunications and radar equipment, and instruments, in those theatres. He rejoined the company on demobilisation in 1946 and was appointed assistant sales manager in 1947. Further appointments followed in 1950, when he became deputy managing director of

Marconi's associated company in South Africa, Marconi (S.A.), Ltd., and in 1951 when, after his return to Marconi's Wireless Telegraph Co., he was appointed assistant commercial manager.

With regard to the recent agreement between the Igranic Electric Co., Ltd., and Dagnall & Kendall, Ltd., whereby the latter company has taken over the Igranic commitments for radio and television, we are now informed that **Mr. J. White,** previously sales manager of the components division of the Igranic Electric Co., has been appointed sales manager with Dagnall & Kendall and the company has also appointed **Mr. J. A. Field,** who was in charge of the development section for the components division of the Igranic Co., as chief engineer.

The resignation of **Mr. A. N. E. McHaffie,** deputy chairman, from the board of the Hotpoint Electric Appliance Co., Ltd., is announced on his retirement from the board of Associated Electrical Industries, Ltd. Three appointments to the board of the Hotpoint Co. have been made with effect from 1st July.

Mr. H. F. Adams, at present general works manager, is made director of manufacture. Mr. Adams joined the British Thomson-Houston Co., Ltd., in 1929 as an apprentice, and obtained his ordinary and higher national certificates in electrical engineering. In 1936 he joined the home appliance planning staff, and a year later became chief planner. He was appointed assistant to the superintendent, home appliance factory, in 1941, and acting superintendent in 1944. In 1945 he became assistant superintendent at the Peterborough factory and in 1949 superintendent. In the following year he was appointed chief superintendent of the Hotpoint group factories, and in 1953 works manager, Peterborough factory. He has been general works manager since 1954. Mr. Adams was chairman of the Institution of Production engineers, Peterborough section, in 1954-55 and 1955-56.

Mr. D. H. Graham, B.Sc. Eng. (London), M.I.E.E., who has been chief design engineer since 1954, has been appointed director of design. He was apprenticed to the British Thomson-Houston Co., Ltd., on leaving Brighton Municipal Technical College. In 1923 he joined the Engineering Department at Coventry, where he engineered the very first f.h.p. motors made by the B.T.H. Co. In 1934 he instituted a design section on accessories for aircraft, and in 1948 transferred to the Llandudno Junction factory of the Hotpoint Electric Appliance Co., Ltd., in charge of design, going to Peterborough in 1954.

Mr. D. T. L. Rettie, M.A., is appointed director of marketing. He was educated at Dulwich College and Magdalene College, Cambridge, and served in the Indian Army from 1941 to 1946, holding the rank of major. Following the end of the war, Mr. Rettie stayed in India until 1947 as a tea broker. He joined Thomas Hedley & Co., Ltd., as production manager on his return to this country, and from 1954 to 1956 was with Beecham Foods, Ltd., as marketing director.

Mr. C. K. Downie, Associate I.E.E., whose article on "Toughened Glass Insulators" appears in this issue, received his early training with Johnson & Phillips, Ltd. He joined the mains department of the West Kent Electric Co. at Crayford in 1934, transferring to the area office of the same company at Orpington in 1936. In 1945 he took up an appointment as assistant engineer in the distribution department of the Grampian Electricity Supply Co. in Perth. Mr. Downie was appointed to his present position of area distribution engineer and assistant area manager of the South Caledonia Area, North of Scotland Hydro-Electric Board, in 1952.

Mr. C. K. Downie

Mr. Leslie Gamage, vice-chairman and joint managing director of the General Electric Co., Ltd., gave a dinner party at the Savoy Hotel on 4th July following the placing in Britain of a £4½ million contract for telecommunication equipment of which the G.E.C. is to undertake a major share. The guest of honour was the Hon. Dr. K. O. Mbadiwe, Minister of Communications and Aviation of the Federation of Nigeria, who was accompanied by the Hon. M. T. Mbu, Commissioner for the Federation; Mr. Alhaji Abdulmaliki, Commissioner for the Northern Region, and Mr. T. O. C. Ojiako, Commissioner for the Eastern Region.

Mr. Leslie Gamage with his guests at the Savoy Hotel, London. Left to right: The Hon. M. T. Mbu, Mr. Leslie Gamage, the Hon. Dr. K. O. Mbadiwe, Mr. T. O. C. Ojiako and Mr. Alhaji Abdulmaliki

As a result of the increasing sales of the Ellison hydraulic valve, George Ellison, Ltd., has appointed **Mr. L. A. Yardley** as engineer responsible for sales and consultative service in Lancashire, Yorkshire, Northumberland, Cumberland and Seotland. His headquarters will be the Manchester office of the company at No. 1, Central Street (telephone: Blackfriars 7637-8). Mr. Yardley has been a member of the technical and sales staff for sixteen years.

The Radio and Electronic Engineering Association announces that **Mr. Neill Christie,** secretary for the past nine years, has relinquished his appointment. A new appointment is under consideration.

Despite the inclement weather well over 250 parents and friends of apprentices of the **British Thomson-Houston Co., Ltd.,** at the Willesden Works accepted invitations to the annual Parents' Day last Saturday. The visitors were conducted around the works by the apprentices themselves and after tea were welcomed by Mr. E. Alexander (manager, Willesden Works). He said that the demand for equipment for the new atomic power stations and circuit-breakers for railway electrification ensured a well-filled order book and that apprentices would be well advised to continue with the company at the end of their apprenticeship.

The chief guest was Mr. C. Grad (manager, Education Department) who gave a short address and presented awards to the successful entrants for the "Easthope" essay competition. First prize went to a first-year apprentice, Mr. J. F. Hunt, for "The Growth of the Steel Industry" and the silver medal for the best essay of the year to a third-year apprentice, Mr. D. E. Howard, for "How Safe is our Factory." The Apprentice Association

Mr. H. F. Adams

Mr. D. H. Graham

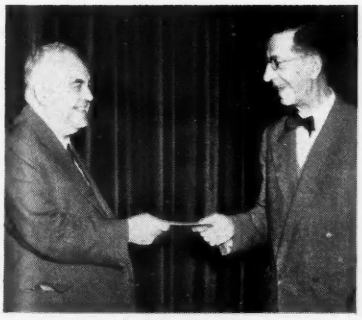
Mr. D. T. L. Rettie

was responsible for the whole of the afternoon's activities and Mr. R. R. Goulding (ex-chairman of the Association) proposed a vote of thanks to everyone for their support.

Mr. H. West, A.M.C.T., M.I.E.E., M.I.Mech.E., has been appointed managing director of the A.E.I.-John Thompson Nuclear Energy Co. A director and chief electrical engineer of the Metropolitan-Vickers Electrical Co., Ltd., Mr. West was associated with the A.E.I.-John Thompson industrial nuclear energy group from its inception and, when this was formed into a company, he became the first chairman of its management committee. He has been elected a member of the Council of the Institution of Electrical Engineers for the ensuing year and we publish his portrait in this connection elsewhere in this issue.

Mrs. Winifred E. Gunton retired on 30th June last after serving the Stella Lamp Co., Ltd., as a lamp sales representative for thirty-six years. Mrs. Gunton, better known as "Stella," began her career as a lamp representative in 1916 and joined Stella Lamps in 1920. During her long service with the company, Mrs. Gunton has covered most of the home and eastern counties and the London area. She was the guest of honour at a luncheon given by the company in London on 6th July.

After thirty-six years' service with the Hackbridge and Hewittic Electric Co., Ltd., **Mr. H. Fraser** retired at the end of June. He was chief of the electrical tests of both transformer and



Mr. H. Fraser (right) receiving a cheque from Mr. A. M. Browne (chairman and managing director of the Hackbridge and Hewittic Electric Co., Ltd.)

rectifier divisions, and to mark the occasion he was presented with a cheque on behalf of his colleagues by Mr. A. M. Browne, chairman and managing director of the company.

Mr. J. E. Hainsworth has joined N. G. Bailey & Co., Ltd., 30, City Road, E.C.1, as their chief engineer (southern region).

Mr. J. H. Senior, F.C.A., has been elected chairman of the Kenwood Manufacturing Co., Ltd. Mr. Senior, who is a partner of Derbyshire & Co., chartered accountants, of High Holborn, succeeds **Mr. S. W. Kallend,** A.C.A., who resigned earlier in the year to take up a full-time appointment in the motor industry. Mr. Senior is a director of a number of companies.

Mr. L. Ruderman, head of the Electrical Department of the Wolverhampton and Staffordshire Technical College, is to retire after thirty-one years at the College. He took over the Electrical and Mechanical Engineering Department in 1925. The department was later divided into two and he was in charge of the electrical section. Mr. Ruderman is moving to Worthing and he hopes to teach part-time at a Technical College, Brighton.

OBITUARY

Mr. A. P. Ross, a representative with the Midland area office of the Atlas Lighting Division of Thorn Electrical Industries, Ltd., since 1948, died on 8th July at the age of fifty-six.

Electrical Industries Golf Championship

The Eastern Area final of the Electrical Industries National Golf Championship was held at the Letchworth Golf Club, Letchworth, Herts, on 11th July. The successful competitors, who now qualify for the national final at Bristol on 1st October, were as follows:—Winner, Mr. A. G. Gray (Bletchley, Bucks); runner-up, Mr. J. L. Taylor (Leighton Buzzard, Beds); and best scratch score, Mr. K. A. Cameron (St. Ives, Hunts). Eighteen players competed, and the meeting was followed by a supper at which the trophies were presented.

The East Midlands Area finals were also held at the Longcliffe Golf Course, near Loughborough, on 11th July. Some 84 competitors took part and the following were the results:—Best net score, Mr. G. W. Rowley (Ashby-de-la-Zouch), second best net score, Mr. J. Whyman (Loughborough); third best net score, Mr. M. Miller (Loughborough); best scratch score, Mr. R. Edwards (Stoke-on-Trent); second best scratch score, Dr. McDowall (Derby); best net score, veteran, Mr. J. H. Field (Birstall); second best net score, veteran, Dr. Magill Young (Loughborough); best net score, visitor, Mr. R. J. Cheshire (Atherstone); second best net score, visitor, Mr. T. Gillen; booby prize, Mr. P. Evans (Loughborough).

The Southern Area finals were played at Brockenhurst Golf Club on 4th July. The following players qualified for the national finals:—First handicap, Mr. J. Shotton (Philips Electrical, Ltd.); 2nd handicap, Mr. B. H. Kirby (Crompton Parkinson, Ltd.). Mr. J. Holton (Southern Electricity Board) qualified for the scratch prize. The chairman of the Southern Area, Mr. R. H. Coates (divisional controller, C.E.A. Portsmouth), presented the prizes in the evening and announced that a cheque for 105 guineas would be sent to the E.I.B.A.

The area finals for South West England were held at Yelverton Golf Course on 3rd July, when 36 competitors took part. The winner of the morning play was Mr. T. Wright, of St. Budeaux, and the runner-up was Mr. S. C. Vercoe, of Barnstaple. There was a greensome match in the afternoon, when Mr. H. Baker and Mr. R. M. S. Lamb tied with Mr. S. C. Vercoe and Mr. W. D. Morgan. A dinner was held in the Clubhouse, when prizes were presented by Mr. E. M. Hughes, chairman of the E.I.B.A., South West England.

Trade Associations: Lord Citrine's Views

ADDRESSING the Duke of Edinburgh's Study Conference at Oxford last week, Lord Citrine, chairman of the Central Electricity Authority, said the assumption that industry to-day was owned by a handful of people was not true. Diffusion had proceeded to a far greater extent than was generally recognised. He believed it was impossible under modern conditions, with a vigilant democracy, for industrial enterprises to exploit their position.

On the subject of price rings, Lord Citrine said that the question was, were the prices that were fixed fair? In the electricity supply industry contracts were placed for very large machines and on orders involving £600,000 to £700,000, tenders were sometimes received identical down to the last shilling. He did not want it to be assumed that he regarded this as necessarily wrong. Just as the trade unionist combined to prevent his standard of life from being driven down, so it seemed to him quite justifiable that among firms there should be some kind of combination to avoid the standards at which they sold their commodities being debased. Lord Citrine said he was certain that disclosures of costs would show that the public was not being overcharged.

Following Lord Citrine's speech Liberal M.P.s tabled a motion: "That this House . . . is of the opinion that no one, while holding these views, is a proper person to safeguard the interests of the Central Electricity Authority or of the users of electricity." An amendment has been put down by two Labour M.P.s to substitute that "Lord Citrine's views are realistic and should be seriously considered."

GENERATION AND DEVELOPMENT

Six Months' Output

The rate of increase in electricity output in the first six months of this year was rather less than in 1955. As shown in the accompanying table, the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board generated altogether 44,678 million kWh in the period January to June this year, an expansion of 8.9 per cent. In the corresponding six months of last year the proportionate increase was 11.8 per cent and for the year as a whole 10 per cent.

At the end of June the total installed capacity of the authorities' generating stations was 23,013 MW, a net increase of 212 MW during the month and 524 MW more than at the end of last year.

ELECTRICITY GENERATED AND PLANT INSTALLED

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	2,923	66	34·6	5,653	3	5,662	5,299	21,073
North of Scotland H.E.B. ...	16	—	1·0	24	69	97	96	722
South of Scotland E.B.	204	4	0·1	372	11	383	361	1,218
Total for June, 1956	3,143	70	35·7	6,049	83	*6,142	5,756	23,013
Corres. total for June, 1955 ...	2,964	77	14·8	5,552	72	5,636	5,287	21,067
Inc. or dec., per cent.	+6·1	—9·0	+141·4	+8·9	+16·2	+9·0	+8·9	+9·2
Total to date (6 months) 1956	22,928	491	207·3	43,871	718	44,678	41,988	
Total for corres. 6 months of 1955	21,486	608	125·6	40,250	697	41,033	38,604	
Inc. or dec., per cent	+6·7	—19·2	+65·1	+9·0	+3·0	+8·9	+8·8	

*The total figure includes generation by other methods amounting to 10 million kWh.

New plant installed in C.E.A. stations last month included the following: Uskmouth "A," 60 MW G.E.C. set; Portishead "B," 300,000 lb/hr Mitchell boiler; Carmarthen Bay, 240,000 lb/hr Babcock & Wilcox boiler; Doncaster "B," 30 MW Brush set; Brunswick Wharf, 60 MW Metropolitan-Vickers set; Littlebrook "C," 60 MW Parsons set; Skelton Grange "A," 550,000 lb/hr International Combustion boiler; Wakefield "B," 550,000 lb/hr Foster Wheeler boiler and 60 MW English Electric set; York, 100,000 lb/hr Richardsons Westgarth boiler; Stella South, 60 MW Parsons set; Carrington, 360,000 lb/hr John Brown boiler; and Ince, 550,000 lb/hr International Combustion boiler.

200 MW Turbo-Generators

Orders for 200 MW turbo-generators for power stations in England and in Canada have been received by C. A. Parsons & Co., Ltd., Newcastle-upon-Tyne. The set for England has been ordered by the Central Electricity Authority; it is a single line unit running at 3,000 r.p.m. and operating with steam at a pressure of 2,350 lb/sq in, a temperature of 1,050 deg F. and with reheating to 1,000 deg F.

The turbo-generator for Canada will be the first 200 MW set to be installed in that country, and the first to be exported from England. It has been ordered by the Hydro Electric Power Commission of Ontario for the Richard L. Hearn generating station, Toronto. This will be the fifth machine to be installed by Parsons in this station, the four previous sets being for outputs of 100 MW and installed in 1951-53. The new machine is of the cross-compound design, the h.p. line running at 3,600 r.p.m. and the l.p. line at 1,800 r.p.m., each being coupled to a 100 MW generator. The operating steam conditions are 1,800 lb/sq in pressure, 1,000 deg F. temperature and with reheating to 1,000 deg F.

Cooker Hire Charges Increased

Owing to the continued increases in cost of equipment and maintenance, Belfast Corporation Electricity Department is revising its cooker hire charges. The rental for a new three-plate cooker will be raised from 15s to 18s 6d per quarter and there will be increases ranging from 1s to 2s in the hire charges for other types of cookers.

Reinforcement in East Fife and Dumfries

The South of Scotland Electricity Board has approved the reinforcement of the system in East Fife at a cost of over £250,000. The second circuit of the Redhouse/Cupar line, at present operating at 33 kV, will be raised to 132 kV, and a 60 MVA transformer will be installed at Cupar. In addition a new grid supply point will be established at Gleniston equipped with a 30 MVA 132/33 kV transformer tee-connected to the Dunfermline/Redhouse line, together with a 33 kV switching station. It is hoped to commission these works before the winter of 1957-58.

A reinforcement of the 33 kV network in Dumfriesshire has also been approved. At the 132 kV switching station associated with the Atomic Energy Authority's nuclear power station at Chapelcross, an additional 132 kV switch equipment is to be installed controlling a 30 MVA 132/33 kV transformer. This transformer will supply a new 33 kV switching station to be built nearby and to which will be connected the Dumfries, Lockerbie and Gretna lines. In addition, new 33 kV overhead lines will be constructed between Chapelcross and Lockerbie and between Gretna and Langholm. The work will be completed in 1958 at an estimated cost of £282,000.

North Wales Power Plans

Outlining the future generating programme of the North West, Merseyside and North Wales Division at a meeting of the Area Consultative Council, Mr. A. R. Cooper, the divisional controller, said that the Festiniog hydro-electric scheme would not be further postponed. In fact, though the start of major work on the Rheidol and Festiniog schemes had been deferred, the divisional and consulting engineers were proceeding with preliminary designs and drawings and were negotiating for land. They planned to have ready the 49,000 kW Rheidol plant and the first two 75,000 kW sets of the Festiniog pumped storage scheme in 1961. An essential part of the latter was the construction

The South of Scotland Electricity Board's showrooms in George Street decorated for the recent Royal visit to Edinburgh

of a 275 kV line from Festiniog to Connah's Quay. Preliminary talks had already been held with planning officers of Flintshire, Denbighshire, Merionethshire and Caernarvonshire about the line's route.

It was also possible that a new generating station, Connah's Quay "B", would be constructed, although no definite decision had as yet been reached.

Atomic Power Costs

On 6th July, Mr. D. Bellamy, chairman of the Yorkshire Electricity Board, attended a meeting at Doncaster between the Yorkshire Electricity Consultative Council and representatives of local authorities throughout the county. He was asked by Coun. J. A. M. Bright (Selby) about the possibility of establishing atomic energy power stations in Yorkshire and whether their introduction would result in a decrease in the price of electricity. Mr. Bellamy, in reply, said that at the present time there were no such plans and also that the introduction of atomic power would not reduce the cost of electricity immediately. It would, however, have the effect of levelling off the price for a long time. After the large initial outlay, the cost of atomic power would probably tend to decrease.

Installations in Council Houses

Ald. Herbert Jackson, chairman of Doncaster Housing Committee, was critical of the Yorkshire Board's policy with regard to the provision of electrical points in new Council houses. He said that points had to be installed in the houses whether they were used or not, and it had the effect of increasing the cost of building homes at a time when local authorities were facing a very difficult financial situation. He was told by Mr. Bellamy that the present cost of supplying electricity to a house was between £50 and £60, compared with £19 pre-war. The Board had to supply houses with electricity and they wanted an assurance that the facilities for people to use the power would be included in the buildings.

Irish Power Resources

It is reported that with the completion of the hydro-electric scheme on the River Lee, in Co. Cork, and the River Clady, in Co. Donegal, both of which are expected to start producing electricity by the end of next year, the Irish Electricity Supply Board will have harnessed 70 per cent of the potential hydro-electric power of the rivers in the Republic. The remaining 30 per cent of potential power lies in 17 other rivers which have been under survey for a number of years.

Besides the two big peat-powered stations at Portarlington and Allenwood, three other large turf stations are being built at Ferbane, Co. Offaly, Lanesborough, Co. Longford and Rhode, Co. Offaly. A large number of smaller peat-powered stations are planned and a station which will use Irish coal is being built at Arigna.

Dublin City uses about a quarter of all the electricity generated by the E.S.B. It is expected that the large oil-burning station at Ringsend will be completed by the end of the year. Two generating sets there have been operational for some time. This new station, and also one at Marina, Cork, have been designed so that the boilers can employ pulverised coal in the event of an oil shortage.

Electricity for Lighting Only

Whickham (Co. Durham) U.D.C. has decided to adhere to its policy of installing gas for cooking and electricity for lighting in new Council houses, despite a warning from the North Eastern Electricity Board that the Board may have to revise its charges. At present the Board lays its cables to each house free of charge while the Gas Board charges 65s for similar work. The Electricity Board suggested that tenants should be given a free choice of either gas or electricity for cooking. The Board added that unless it could be assured of a reasonable return on its outlay, the question of providing electricity cables free to each house would have to be reconsidered.

U.S. Niagara Station Wrecked

A rock fall in the Niagara River gorge last month destroyed 234,000 kW of the 334,800 kW of plant in the Schoellkopf station of the Niagara Mohawk Power Corporation, states the *Electrical World*. Sections B and C of the station were completely wrecked. The remaining 100,800 kW of plant in Section A was flooded. The city of Niagara Falls was without power for about eight hours, the supply being restored by drawing on interconnections with the Ontario Hydro-Electric Power Commission and others.

Nuclear Station for Ulster

White Paper Envisages 200 MW Capacity by 1964

THE nature and scope of future power supply and demand in Northern Ireland are forecast in a White Paper published by H.M. Stationery Office, Belfast, price 1s. Based on the recent growth of peak load (from 220 MW in 1948 to 340 MW in 1955) it is estimated that the annual plant addition required will rise from about 25 MW in the early years to more than 70 MW in the late 1960s. In the five years immediately following 1959-60 some 280 MW of generating plant will be needed, including 60 MW for replacements, and in the succeeding five years 380 MW.

Because of the lack of coal in Northern Ireland the Government is particularly interested in the development of nuclear power stations and the establishment of such a station in time to meet the need for additional capacity in 1960 was considered but was not felt to be feasible. The present hope is that a station with a capacity of 200 MW (two 100 MW generators) may be brought into operation in 1963-64. Expansion to double that capacity would, on present estimates, provide sufficient power up to 1969.

If the course of nuclear development indicates that it would be advantageous to defer this plan the alternative would be to install up to three additional 30 MW sets in a new thermal station to be built at Londonderry and perhaps to proceed with the Bann (15 MW) and Mourne (42.5 MW) hydro-electric schemes. The White Paper makes it clear, however, that it is not intended to resort to any of these alternatives if it can be avoided. The Ministry, it is stated, is satisfied that the hydro-electric schemes would provide economical sources of power but in view of the strong local objections and the small contribution the plant would make to the total electricity supply it has not yet confirmed them. "They cannot, however, be lightly abandoned," the report adds.

The plans for increased plant are divided into short term and major programmes. The capital cost of the former, covering the period 1955-62, is estimated at £7.5 million, made up of £4.5 million for the new Londonderry station (60 MW), £2 million for a 30 MW addition at Ballylumford and £1 million for 110 kV transmission extensions.

Under the major programme, providing for demands up to 1968-69, if a nuclear station could be brought into initial operation in 1962-63, its capacity increased to 200 MW in 1964 and subsequently expanded by 100 MW each year, the cost would be some £66 million, taking £140/kW for the plant and £25/kW for the "fuel" stock. If, however, this station did not come into operation until 1964-65, some £4 million would have to be spent before that on expanding the Londonderry station. If the nuclear station could not be ready until 1965-66, full expansion of the Londonderry station would be required at a cost of some £6 million and the hydro-electric stations would probably have to be established at a cost of some £6.5 million. The maximum capital cost of the major programme would be nearly £80 million but this might be substantially reduced by developments in the design and construction of nuclear stations.

The White Paper says it is intended that both programmes shall be carried out by the Electricity Board for Northern Ireland and legislation to extend the Board's borrowing powers will be proposed in due course.

Financial Section

STOCKS and SHARES

ALTHOUGH business in most sections of the Stock Exchange has been held in suspense by uncertainty over the labour problems of the motor and other trades, the industrial markets were showing a harder tendency by the beginning of this week. The ordinary shares of A.E.I. and G.E.C. recovered to the extent of 2s 6d; the latter company's final dividend is expected to be declared next Tuesday, 24th July. Ward & Goldstone also regained 2s 6d to 36s 3d, and there were material improvements in Chloride Electric, Decca, Vactric, Electric Construction and some others. Motor accessories shares were under less pressure. A further rise in British Aluminium carried the price to 67s 6d, which is some 15s above the level at mid-May, when the company launched its big issue of new shares in connection with the financing of the Quebec smelter project. Ultra Electrics were active and higher around 9s 9d.

New Issues

Power Securities new £1 ordinary shares, offered to shareholders at 28s, advanced strongly to 41s 3d after the last day for acceptance of allotments, and for payment, had been passed. They will remain transferable free of stamp duty until 10th August, and are showing a yield of a fraction under 5 per cent on the basis of the 10 per cent dividend paid for last year. British Tabulating Machine 10s shares recovered well, to 50s, from their earlier reaction to news of the impending issue of shares at 27s, by way of rights to existing shareholders. Dealings began this week in the new £1 shares offered at 35s to shareholders of Telephone & General Trust. In the early stages they changed hands at a premium of 3s 6d. For last year the company paid a 12 per cent dividend.

Aiton & Co. Results

The 10s shares of Aiton & Co., whose power pipework and other products go largely to the Central Electricity Authority, were marked up 1s, to 44s 6d, after the announcement of the annual results. They yield 4½ per cent on the present rate of dividend, which is again brought up to a total of 20 per cent by the final distribution now declared. Earnings (including transfer to profits in suspense) have expanded from £450,000 to £512,000. The net surplus of £250,000 after tax appears to cover the distribution eight times over, a large margin even if allowance is made for the company's previous advice that, since most of the work is based on long-term contracts, the annual profits may not be truly representative of the earnings of a particular year. According to the company's latest statement, the volume of orders on hand and being received remains very satisfactory.

W. H. Allen

The £1 ordinary shares of W. H. Allen, Sons & Co. are now quoted ex

Price Changes in

Company or Board	Nom. Value	Middle price 16th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	75½	+ 1	3	3	3 19 6	80½	74½
Brit. Elec. 1974/77	100	73½			3	4 1 9	79½	73⅜
Brit Elec. 1976/79	100	77½		3½	3½	4 10 3	84	77½
Brit. Elec. 1974/79	100	88½		4½	4½	4 16 0	95	88
Overseas Electric Supply								
Calcutta Elec.	£1	19/6		6†	6†	6 3 0	20/9	19/-
East African Power	£1	19/-		7	7	7 7 3	21/3	19/6
Nigerian Elec.	£1	18/6		10	10	10 16 3	21/-	17/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	21/-	21/-
Perak Hydro-Elec.	£1	16/-		10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/-		17½	17½	7 19 0	13/6	10/6
Aerialite	1/-	4/6	− 3d.	88½	45*	10 0 0	6/9	4/9
Allen, W. H.	£1	37/6		20	10*	5 6 8	39/-	33/6
Aron Elec. Ord.	£1	55/9		15	15	5 7 6	56/-	53/6
Assd. Automation	10/-	17/-		10	5	2 7 3	—	17/-
Assoc. Elec. Ord.	£1	68/9	+ 2/6	14	15	4 7 3	85/6	57/9
Automatic Tel. & El.	£1	56/3		15	15	5 6 9	72/6	56/3
Babcock & Wilcox	£1	73/6		15	15	4 1 9	85/6	64/-
Baldwin, H. J.	2/-	5/-	+ 3d.	20	20	8 0 0	5/-	3/9
Bakelite	10/-	27/6		16	16	5 16 6	34/-	26/9
Berry's Electric	5/-	6/6		—	10‡	7 13 9	6/6	5/9
British Aluminium	£1	67/6	+ 1/9	12	12	3 11 0	68/3	40/6
B.I. Callender's	£1	50/6	+ 6d.	10	12½	4 19 0	54/3	45/-
B.I. Callender's 6% Pref. ...	£1	20/6		6	6	5 17 0	22/6	20/3
British Thermostat	5/-	25/-		20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	6/-		30	15*	12 10 0	8/9	6/-
Brook Motors	10/-	36/3		20	25	6 18 0	44/-	36/3
Brush Ord.	5/-	5/9		10	10	8 14 0	7/9	5/9
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/3
Burco Dean	5/-	8/6		—	22½	13 4 9	13/3	8/6
Chloride El. Storage "A" ...	£1	62/6	+ 1/3	17½	17½	5 12 0	73/6	60/9
Clarke Chapman	£1	105/-		20	22½	4 5 9	112 6	89/6
Cole, E. K.	5/-	15/6		17½	17½	5 13 0	22/3	15/6
Cossor, A. C.	5/-	6/9		10	15	11 2 3	10/3	6/9
Crabtree	10/-	27/-		20	20	7 8 3	29/3	27/-
Crompton Parkinson Ord. ...	5/-	12/6	− 9d.	20	16*	6 8 0	15/-	12/3
De La Rue	5/-	17/3	− 1/-	30	30	8 14 0	20/3	15/-
Decca	4/-	27/6	+ 1/3	56¼	43¾*	6 7 3	44/9	24/9
Desoutter	5/-	30/6	+ 1/6	25	30	4 18 3	32/9	25/9
Dewhurst	2/-	6/6		24	30	—	7/6	5/3
Dictograph Tel.	2/-	5/9		20	20	6 19 3	6/9	5/9
Dubilier Condenser	1/-	3/9		25	25*	6 13 3	4/6	3/6
E.M.I.	10/-	26/6		10	15	5 13 3	37/-	26/3
Electrical Components	5/-	12/6		20	25	10 0 0	16/-	12/6
Elec. Construction	£1	26/3	+ 1/-	8½	8½	6 9 6	29/9	25/-
Enfield Cable Ord.	£1	14/6	+ 1/-	Nil	Nil	Nil	19/3	13/6
English Electric	£1	51/3		12½	12½	4 17 6	66/3	47/3
English Electric 3¾% Pref. ...	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	35/6		20†	20†	2 16 3†	42/9	33/6
Ever Ready	5/-	26/9	+ 1/-	35	35	6 10 9	32/9	24/-
Falk Stadelmann	£1	36/3		15	17½	9 13 0	45/9	36/9
G.E.C. Ord.	£1	56/3	+ 2/6	12½	14	4 19 6	65/6	50/-
G.E.C. 6½% Pref.	£1	22/6		6½	6½	5 15 6	23/9	21/3
General Cables	5/-	11/3		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3	− 1/3	17½	17½	7 11 3	47/6	45/-
Hackbridge Cable	5/-	22/9	+ 6d.	20	25	5 10 0	24/6	18/9
Hackbridge & Hewittic	5/-	18/3		30	23*	6 6 0	22/-	17/3
Heatrae	2/-	3/9		15	15	8 0 0	5/1	3/9
Henley's	10/-	15/9	− 6d.	10½	11½	7 6 0	19/9	14/-
Holophane	5/-	19/9		25	30	7 12 0	19/9	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
*After scrip issue. †Free of income tax. ‡Dividend forecast.

the share-for-share scrip issue. They stand at 37s 6d, with the new shares a few pence higher, being transferable free of stamp duty for the time being. Results for 1955 showed a 14 per cent improvement in the net profit at £424,000 (after tax), which covers fully four times over the amount of the dividend. This has been brought up to a total equivalent to 10 per cent on the present one-class capital of just over £2 million. It is in line with the previous year's payment, part of which, however, was declared in the form of a bonus. The yield of a little under 5½ per cent on the shares is in correspondence with the average current return from high-grade engineering investments. Recently the company made a private issue of £800,000 debenture stock towards the financing of the development programme.

Electrical Investments

Company or Board	Nom. Value	Middle price 16th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	25/-		70	50	10 0 0	39/3	23/-
I.C.I.	£1	44/9	+ 1/3	10	10	4 9 6	49/9	41/3
Intl. Combustion	5/-	18/6		25	20*	5 8 0	25/-	15/3
Johnson & Phillips	£1	40/9		15	15	7 7 3	46/6	37/6
Lancashire Dynamo	£1	42/6		15	11*	5 3 6	49/9	40/9
Laurence, Scott	5/-	15/3	− 3d	12½	15	4 18 3	16/9	13/3
Lister, R. A.	£1	30/-		9.3	10	6 13 3	35/3	27/6
London Elec. Wire	£1	50/-		12½	12½	5 0 0	52/9	46/5
Lucas, J.	£1	29/6		7½	7½	5 1 9	40/3	29/6
Marryat & Scott	2/-	11/3		30	30	5 6 9	11/3	9/6
Mather & Platt	£1	51/6		13.6*	15	5 16 6	65/3	51/6
Metal Industries	£1	18/-		9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	20/-		35	50	10 0 0	27/3	20/-
Murex	£1	68/3		15	20	5 17 3	70/3	60/-
Newman Ind.	2/-	2/3	− 3d	10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/3		20	17½*	7 15 6	3/-	2/3
Parnall (Yate)	5/-	5/9		14	12	10 8 9	9,6	5/6
Parsons, C. A.	£1	80/-		10	10	2 10 0	85/-	61/6
Plessey	10/-	68/6	+ 1/-	27½	30‡	4 7 6	87/6	56/-
Pye "A" Deferred	5/-	16/3		20	12½*	3 17 0	21/3	14/-
Revo	10/-	14/3	+ 6d	9	9	6 6 3	14/6	8/3
Reyrolle	£1	100/-		15	16½	3 5 0	110/-	81/-
Rheostatic	4/-	9/6	+ 6d	18½	12‡	5 1 0	—	8/3
Richardsons Westgarth	5/-	15/6		16½	16½	5 7 6	17/-	13/9
Scottish Cables	4/-	16/3		27½	27½	6 15 3	17/9	15/9
Smith (England), S.	4/-	10/6		17½	17½	6 13 3	14/3	10/6
Southern Areas	£1	17/6		10	7½	8 11 6	28/9	17/6
Strand Elec.	5/-	7/3		17½	15*	10 6 9	8/6	7/3
Sturtevant	5/-	22/6		14.4†	15†	3 6 9†	31/3	22/6
Sun Elec.	£1	35/-		15	20	11 8 9	37/6	35/-
Switchgear & Cowans	5/-	13/9		20	25	9 1 9	17/-	13/6
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	43/-		25	25	5 16 3	45/-	40/6
T.C. & M.	£1	28/-		8½	8½	6 1 6	34/-	26/-
Telephone Mfg.	5/-	7/-		10	10*	7 2 9	8/6	6/3
Thorn Elec.	5/-	17/6		20	15*	4 5 9	22/6	16/-
Thornycroft	£1	42/6		15	15*	7 1 3	49/9	41/3
Tube Investments	£1	55/-		22½	14*‡	5 1 9	70/6	54/9
Vactric	5/-	12/6	+ 6d	15	17½*	7 0 0	15/-	11/6
Veritys	5/-	8/-	+ 1/-	12½	12½	7 16 3	10/-	6/9
Walsall Conduits	4/-	12/9		70	20*	6 5 6	13/6	10/9
Ward & Godstone	5/-	36/3	+ 2/6	30	35	4 16 6	38/3	29/-
Watford	2/-	6/3		25	25	8 0 0	7/6	6/3
Westinghouse	£1	72/6		18	18	4 19 3	100/-	71/6
West, Allen	5/-	12/3		15	15	6 2 6	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	75	+ 1	6	6	8 0 0	80	66
Ord.	100	47½		3¾	3¾	7 18 0	54	45
Anglo-Portuguese	£1	23/-		8	8	6 19 3	23/6	20/3
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	16/6	− 6d.	22½	22½	6 16 3	20/-	15/6
Cable & Wireless:								
Ord.	5/-	10/3	+ 3d	10	10	4 17 6	11/3	9/6
4% Loan	100	90½		4	4	4 8 6	92½	88
Calcutta Trams	£1	24/-	− 1/-	6†	7½†	6 5 0†	26/3	23/-
Cape Elec. Trams	£1	18/3		5½	7½	8 4 6	20/3	18/-
Marconi Marine	£1	31/6		10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	75/-	+ 5/-	16	—	—	90/-	67/6
Telephone Rentals	5/-	10/9		12½	12½	5 16 3	11/9	9/9

Outlook

At the recent annual meeting the chairman of Scottish Cables reported that the current year had started with full order books. Subject to the unexpected, he was confident that the next results would again be satisfactory. The year's dividend has been maintained at 27½ per cent from increased earnings. Orders on hand for James Scott (Electrical Engineers) are said, in the chairman's review accompanying the full report, to be at the highest level in the company's history. The rate of completion of some of the orders for the Electricity Boards would be retarded by the instructions to the Boards for a slowing down of their expenditure on distribution development. In this case also, the chairman has under review a year of expansion. On the 18 per cent dividend the company's 5s shares at 11s 6d return 7.8 per cent.

K.G. (Holdings)

The 1s shares of K.G. (Holdings) which have given some spectacular performances since the reorganisation of the business have experienced a revival of activity on news of the company's further acquisitions in the electronics field. They have been dealt in subsequently at around 5s 6d, which compares with this year's extremes of 7s and 5s 2d, and with the price of 1s 3d, at which they stood not much more than a year ago. A dividend of 12½ per cent was paid last November. The latest acquisition carries on the policy of expansion by the purchase of established firms, most of them concerned with electrical and mechanical engineering.

Canadian Investments

For an all-round investment in the future of Canada's public utility industries, the market calls attention to the common shares of Power Corporation of Canada. This is a big holding company with its funds invested mainly in the Dominion's principal electricity undertakings, including B.C. Power and Shawinigan Power, and interested also in other fields which cover banking, oil and a variety of industries. It has a record of impressively consistent expansion, which has enabled the company to raise the dividend in every year except one since the war. On the latest dividend of $2 per share, the yield works out at about 3 per cent with the quotation at $125. The sterling equivalent of £25 per share looks heavy by our standards, but there is seldom any particular difficulty in dealing in small numbers.

REPORTS AND DIVIDENDS

The Telephone Manufacturing Co., Ltd.—The annual meeting was held on 9th July, Mr. F. T. Jackson (chairman) presiding. In his circulated statement Mr. Jackson said although the company had a difficult year during 1955 as a result of shortages both of material and labour, it nevertheless was successful in increasing the value of goods delivered by 20 per cent, when compared with 1954, and of the total 19 per cent was exported. Incoming orders during the year had shown an increase in almost every section of the business, with the British Post Office heading the list. The Canadian branch operated at a loss for the year, but the orders taken showed a considerable increase over any previous year. The Telephone Manufacturing Co. (Australia), Pty., in which they had a third interest, continued to do good business and its factory was working to capacity.

James Scott & Co. (Electrical Engineers), Ltd., held their annual meeting on 31st July. In his review of the past year, Mr. I. Sclar (chairman) said that it had been a particularly busy period. The new factory at Finnieston was occupied in January of this year and was already producing control panels. It was hoped that this factory would be able to develop the manufacture of specialised instrumentation and control switchboards. The space released at St. Vincent Street, Glasgow, was being modified to provide extended showrooms and servicing of electronic and other equipment. In order to develop in the electronics field, they had recently acquired an established engineering and manufacturing unit and were building up a team of research and electronic engineers. The Aberdeen contracting workshops were opened and workshop premises were acquired in Newcastle which were being reconstructed. The premises adjoining the Morrison Street (Edinburgh) showrooms had been acquired and premises had also been acquired in Perth. Orders in hand at the beginning of the financial year were at the highest level in the history of the company. Some of these included overhead distribution work for Electricity Boards. The Dounreay atomic energy contract was proceeding according to schedule, and further contracts had been received from the Atomic Energy Authority for similar work. The retail section of the turnover had been maintained to date.

Permali, Ltd.—In his review of the year ended 31st March last, which has been circulated with the report and accounts, Mr. C. F. Hitchins (chairman) says that during the year they acquired the manufacturing plant, processes and goodwill of a company making a proprietary material known as "Jabroc." A further division has been set up which is devoted to the manufacture of glass fibre laminates which will be marketed under the trade name "Permaglass." Applications for it should be found in various sections of the electrical and general engineering industries. Permali (Canada), Ltd., has been operating for four years as a selling organisation and sales in Canada have built up satisfactorily. Permali, Inc., has set up a plant at Mount Pleasant, Pennsylvania, for the production of Permali in the United States. A number of orders have been received from electrical manufacturing companies in the United States.

Oldham & Son, Ltd., report group profits for the year to 31st March last of £398,419, as compared with £452,958 for the preceding year, and, after deducting taxation of £205,576, the net balance is £192,843 (against £230,124). It is proposed to pay a final dividend of 10 per cent, making 17½ per cent for the year on capital raised from £400,000 to £500,000 by a 25 per cent scrip issue. For the previous year the total distribution on the smaller capital was 20 per cent.

Drake & Gorham, Ltd.—The consolidated trading profit for the year ended 31st March last, before taxation of £30,572, is £56,162, as compared with £62,790 for the previous year. The dividend for the year is maintained at 7½ per cent.

Simon-Carves, Ltd.—At the annual general meeting held on 9th July, shareholders approved the board's proposals that the capital of the company be increased to £2,000,000. Resolutions were also passed for the capitalisation of £500,000, being part of the balance standing to the credit of the share premium account, and for the scrip issue of one new ordinary share of 5s for each two ordinary shares held.

Aiton & Co., Ltd.—Including profits in suspense of £96,849, the trading profit for the year to March 31st last was £511,632, as compared with £450,863 for 1954-55, and after providing £175,509 for taxation the net profit is £250,314 (against £200,326). It is proposed to pay a final ordinary dividend of 12½ per cent., maintaining the distribution for the year at 20 per cent.

The Radio & Television Trust, Ltd. The group profits for the year ended 31st March last amounted to £82,203, as compared with £47,234 for 1954-55. Nothing is added this time for adjustment of bank interest for previous years (against £41,500) and after deducting taxation of £37,939 the net profit is £44,264 (against £50,543). The debit balance on profit and loss account was £501,385, which has been reduced by £2,398 on the liquidation of a non-operating subsidiary. After deducting the profit, the balance carried forward amounts to £454,723, comprising £509,034 losses carried forward in the holding company's accounts, less £54,311 carried forward in the accounts of the subsidiaries.

Associated British Engineering, Ltd., reports a group trading profit for the year ended 31st March last of £528,636, as compared with £305,524 for the preceding year, to which is added other income of £17,487. Taxation absorbs £209,954, and the net profit is £280,564 (against £151,795). General reserve receives £200,000, and the dividend for the year on the ordinary stock is maintained at 10 per cent. by a final payment of 6 per cent. The balance carried forward is £77,501 (against £48,998 brought in).

The Harland Engineering Co., Ltd., announces that of the 400,000 new shares of 5s each provisionally allotted to ordinary shareholders at 7s 6d per share, approximately 97½ per cent have been taken up. Applications for excess shares have been scaled down.

New Companies

E. and H. Hornsby Electrical Co., Ltd.—Registered 20th June. Capital £5,000. Manufacturers and repairers of, agents for and dealers in radio and television sets, gramophone records, gramophones, electrical fittings, etc. Directors: E. Hornsby, Mrs. Ellen Hornsby and S. Pilcher. Regd. office: 280, Heneage Road, Grimsby, Lincs.

Water Heating Co. (Birmingham), Ltd.—Registered 25th June. Capital £1,400. Electrical contractors and engineers, etc. Directors: J. J. Ford, Diana N. Hoff and Dorothy N. Hoff. Regd. office: Sun Building, Bennetts Hill, Birmingham, 2.

Dudley Bower & Co., Ltd.—Registered 23rd May. Capital £10,000. Electrical engineers and contractors. Directors: D. A. A. Bower, W. M. Hume and A. G. Milton. Regd. office: Briset House, Briset Street, London, E.C.1.

Liquidations

Malmesbury Electronics, Ltd.—Winding up voluntarily. Liquidator, Mr. A. G. B. Gunn, 59, New Cavendish Street, London, W.1, appointed 29th June. Particulars of claims to the liquidator by 10th August.

Meifod Electricity Co., Ltd.—Winding up voluntarily. Liquidator, Mr. H. F. J. Cadwallader, Eagle House, Severn Street, Welshpool, Mon, appointed 3rd July.

Bankruptcies

N. D. Keene, carrying on business at 78, Llewellyn Street, Pontygwaith, Glam, under the style of N. & D. Keene, as a radio, television and electrical contractor.—Receiving order made 4th July on debtor's own petition.

F. Robinson, carrying on business at 78, Scholes, and 112, Frog Lane, Wigan, electrical contractor.—Trustee, Mr. A. K. Ferguson, West Africa House, 25, Water Street, Liverpool, 2, Official Receiver, released 29th June.

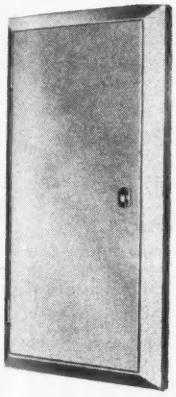
K. M. Ashworth and **D. Revell,** trading in co-partnership under the style of Ashworth & Revell, at 265, Bradford Road, Frizinghall, Bradford, and at 120, Otley Road, Shipley, electrical contractors.—Last day for receiving proofs for dividend 24th July. Trustee, Mr. G. E. Rushton, 36, North Parade, Bradford, 1.

H. W. Daldry, lately carrying on business at 168, Bells Road, Gorleston-on-Sea, Suffolk, electrician.—Order made 7th June suspending discharge for one month, debtor consenting for judgment to be entered for the sum of £100.

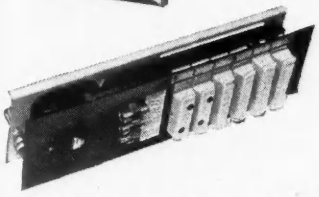
NEW ELECTRICAL EQUIPMENT

Consumers' Control Units

A series of consumers' control units, to B.S. 1454-1948, designed to house all the control gear and metering equipment associated with the electricity supply for modern dwellings, has been introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. They are available for flush, semi-recessed or surface mounting, the cabinets being constructed in 16 s.w.g. mild steel finished in cream enamel on all visible parts. Internal fittings consist of a removable 14½in by 11¾in metal meter panel, a compartment to house the control panel, cable channels, a mounting plate for the cut-outs and cable chambers (house pattern only), and fixing screws to take the brass earth connector block for use with tough rubber sheathed cable.



All cabinets are designed to take a standard proprietary type panel and the panels are designed for a.c. single-phase supplies rated 60 A up to 250 V. They consist of a skeleton type unit



G.E.C. consumers' meter and control unit, semi-recessed pattern, and control panel ready for fitting

with a 60 A d.p. micro-gap main switch controlling a fuse bank of h.r.c. or rewirable fuses in 5, 15 or 30 A capacity. An insulated panel with circuit indicator card protects all live parts in such a manner as to allow the safe replacement of fuses while the main switch is in the "on" position.

Transistor Record Player

A portable 45 r.p.m. record reproducer employing transistors and battery operated has been produced by PHILCO (GREAT BRITAIN), LTD., Romford Road, Chigwell, Essex. In a small compass there is a turntable and pick-up, four 1½ V U2 batteries, a 5in speaker, a record-storage compartment and the four-transistor amplifier arranged on the printed-circuit system. It is claimed that up to 1,500 "sides" can be played without

Philco transistor-operated portable record player

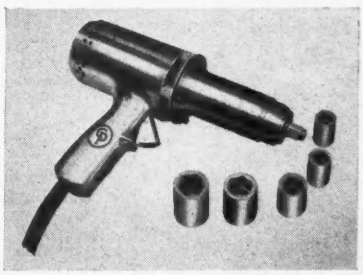
change of batteries. There is a speed adjustment to compensate for the running-down of the batteries.

In addition to its use as a record player the set can be used with a microphone as a "baby alarm"; as an intercommunication unit (with a specially designed Philco speech unit); or as a sounder in conjunction with a morse tapping key.

The price, including purchase tax, is 25 guineas; the accessories mentioned are extra.

Impact Wrench

A new "plug-in-anywhere" electric tool for nut running and many other operations has just been introduced by the CONSOLIDATED PNEUMATIC TOOL CO., LTD., of 232, Dawes Road, London, S.W.6. This is the CP-725EW electric impact wrench which will operate from any standard electricity supply. It has a ½in square drive which will take a full range of sockets for every size of hexagon and square nuts within its rated capacity.



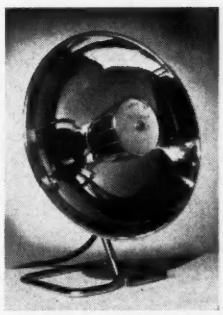
Consolidated Pneumatic electric impact wrench and nut running fittings

It will run-up and back-off nuts in a matter of seconds with a security greater than that obtainable by hand methods.

The tool is specially designed with a slim profile so that it can be applied to nuts in narrow spaces, and there is also a special angle head attachment which enables the tool to be employed on work in most difficult-to-get-at positions. The wrench, by reason of its rotary impacting action, is also ideal for operating stud-drivers, sleeve pullers, gear pullers, taps and dies and screw extractors; and handles all wood, lag, and self-tapping screws as used in bodywork. A full range of screwdriver attachments is available for various sizes of slotted head and Phillips screws. Other attachments include socket adaptors, universal joints and ½in square drive extension bars.

Heating Appliances

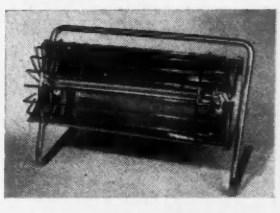
Two new additions to their range of domestic heating appliances, a medical lamp and a reflector fire, are



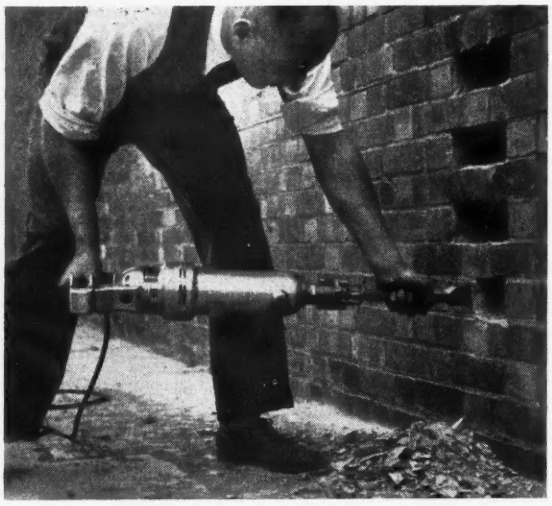
"Healthway Three" medical lamp

announced by METWAY ELECTRICAL INDUSTRIES, LTD., Canning Street, Kemp Town, Brighton, 7. The medical lamp, the "Healthway Three," consists of a 10½in diameter adjustable polished reflector on a chromium plated tubular steel base. A 250 W infra-red heating element is employed. The price is £1 10s plus 13s purchase tax in the United Kingdom.

The "Cradleway" fire has an adjustable nickel plated reflector and guard and is mounted on a chromium plated tubular steel base. It measures 8¼in high by 13¼in long by 6in deep, and the loading of the rod type element is 1 kW. The price is £1 10s 9d plus 13s 4d purchase tax.



"Cradleway" reflector fire



PORTABLE TOOLS AND BUILDING

Use of Electrically Powered Hand Types

By A. O. Williams,
M.B.E., L.I.O.B., A.B.I.C.C., A.R.San.I.

Left: Cutting pockets in brickwork for bonding-in new brickwork, with an electric hammer

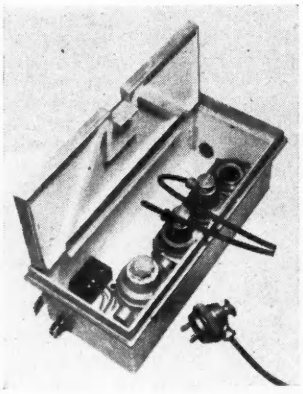
ELECTRICALLY powered tools have been devised to perform most of the tasks on a building site normally done with hand tools, and to perform them at a greater speed and efficiency. No one would dream of returning to the days of hand mixing concrete, converting timber by hand or any of the other old-fashioned methods once common to the industry. Yet there are many laborious tasks which could be performed more cheaply and efficiently by the introduction of powered hand tools. Many of these are adaptable to a variety of uses and foremen need to be aware of all the possibilities: planning ahead is essential.

If sufficient thought is given to the selection of the tool the purchase can pay for itself over and over again. The price is within the reach of every builder and is often recoverable within the space of a single contract: it has been estimated that if a tool is used for no more than eight hours a week it is a paying proposition.

It is wise to consider for what type of work a tool is principally required as it is false economy to purchase something which is not of sufficient capacity; overloading results in damage which may demand a major repair and lead to the unfair condemnation of an otherwise satisfactory tool.

Among the laborious tasks which can be performed with greater speed and efficiency and with less fatigue are "Rawlplugging," cutting corrugated sheets, stair trenching, ripping flooring, drilling tanks, beams, stanchions, etc. The cutting of stoneware pipes, corrugated asbestos sheets and the like, often results in considerable wastage which can be practically eliminated by using powered hand tools.

Much of the work on a building site is by its very nature hard labour and one of the differences between a first-class craftsman and an unskilled worker is that the former by his own ability and knowledge reduces the effort he has to put into his work to get the best results.



Small power distribution box

Portable tools can make a job still easier for the craftsman without in any way robbing him of his skill, and by reducing fatigue an increase of output should result.

The tools which may be used in building work together with the operations which they can carry out, are given in the accompanying schedule.

If full use is to be made of portable powered tools on

USES OF ELECTRIC TOOLS

Tool	Operation
Circular saw	Ripping and cross-cutting, mitring, rebating of timber. Cutting stone, chasing stone or brick, cutting tiles and slates, bricks, S/G stoneware pipes, concrete. Cutting lead, m.s. piping, r.w. goods, corrugated iron or asbestos sheets, aluminium, etc.
Jig saw	Shaping, pattern cutting, tracery. Cutting sheet metal, plastics, asbestos sheets, aluminium, etc.
Chain saw	Log or baulk sawing. Tree felling, lopping, logging.
Drill	Drilling, dowelling, chisel mortising, sanding, light turning, lathework. Drilling small holes in brick, stone, concrete, glazed tiles, etc. Holing tanks, drilling metal, steel beams and stanchions, "Rawlplugging" and fixing r.w. goods, paint mixing, decarbonising mixer, car or lorry.
Hammer	Rough shaping heavy timber. Cutting chases in brick or concrete, scaling, vibrating or tamping concrete, hacking surfaces for plaster, raking out joints, drilling large holes. Descaling tanks, caulking, fixing r.w. goods, demolition work.
Disc sander	Sanding, shaping and roughing out, adzing, polishing. Polishing and grinding stone, terazzo, concrete, brick, tiles, etc., cleaning down. Smoothing metal surfaces, cutting metal, grinding welds, preparing wood or metal for painting, polishing, buffing.
Belt and orbital sanders	Sanding with the grain, finishing joinery, sanding floors.
Planer and woodworker, router and houser	Surfacing, moulding, rebating, routering, dovetailing, housing, moulding, trenching, tracery and light spindle work.
Chain mortiser	Mortising framing, mortises for locks, pin hinge slots.
Screwdriver	Nut running.
Shears and nibblers	Cutting sheet metal and synthetic plates, slotting and circular cuts.

site an efficient power distribution system is necessary. Some form of protection must be provided for the distributor box and cables to vulnerable points on the site must be protected from damage by impact or abrasion. Junction boxes of the weatherproof type fitted to the cables provide plugging points for tools. Overhead distribution is probably the best method of getting current to the required point as it is more flexible than buried cables and is cheaper but care must be taken that sufficient clearance exists to avoid fouling by lorries delivering materials to the site. Where plant is being extensively used thought must be given to the positioning of the cables to reduce the risk of cranes, excavators, etc., causing damage or of the operators of such machines receiving shocks.

Electricity Supply Arrangements

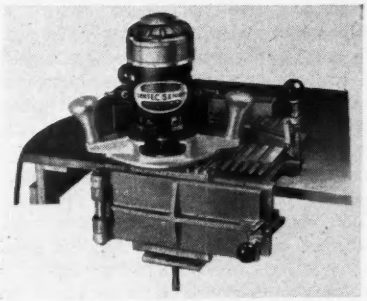
It is of course essential that as much notice as possible should be given to the local office of the electricity authority so that a temporary supply can be provided by them at the site.

Where it is impossible to secure a mains supply, portable generating plant can supply all the power necessary to operate a range of small portable tools. Such generators with outputs ranging up to 40 kW are usually worked by an air-cooled diesel engine. Small 1½ kW and 3 kW types can be had which are sufficient to run a dozen tools and, mounted on two rubber tyred wheels, they are sturdy and reliable, easily transferable and capable of working under almost any conditions. Many of them also have the advantage of being adaptable for use as pumps or for working other small plant on the site.

Practically all standard tools are fitted with motors for the normal range of voltages, i.e. 100-110 V d.c. and 220-250 V a.c. Care must be taken that tools are properly earthed and that the correct fuses have been installed. Cables should be checked for damage or chafing of insulation at regular intervals and they should not be trailed over rough surfaces. Where they have to be taken through doorways, windows, etc., some protection should be given from chance slamming of doors or windows and the attaching of cables to steelwork should be avoided or when this is not possible the fixing should be well insulated.

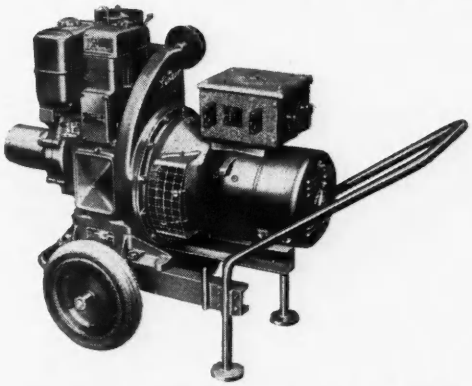
To minimise the risk of injury from electric shock and give a greater measure of safety in handling, tools wound for low voltage, 110 V with centre point earthed, have been introduced in recent years. In use and efficiency they are identical with standard models but care should be exercised in choosing the correct transformer, which can be installed as a permanent fixture in a workshop or as a portable item on the site. If the latter, it must be treated as a portable apparatus at mains voltage for which special earthing and maintenance precautions are laid down.

In an endeavour to raise the safety factor even higher, one manufacturer offers equipment for operating at 50 V.

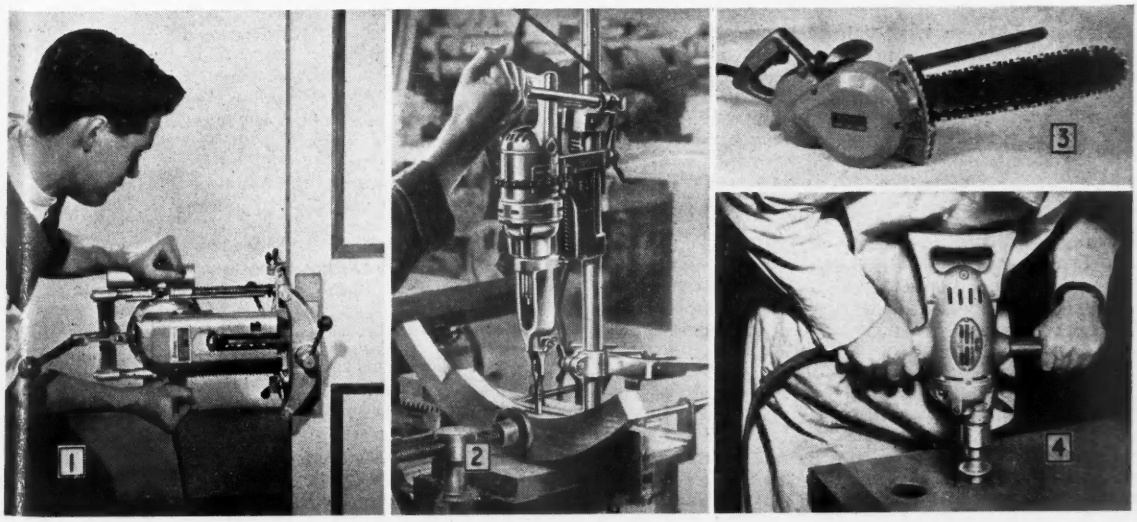


Dovetailing attachment being used with a router

Portable diesel generator set for a temporary supply of site power



1. *Portable chain mortiser clamped to a door for cutting the lock mortise.* **2.** *Drill adapted for chisel mortising using a bench stand.* **3.** *Small electric chain saw.* **4.** *The use of a hole saw for drilling storage tanks*



This does, however, cause a slight loss of efficiency in the machine and necessitates heavy cabling; existing standard voltage machines can be converted to the lower voltage.

Although electric powered hand tools undergo rigorous testing during manufacture their continued efficiency depends largely upon the amount of maintenance they get and the care exercised in their use. A regular weekly check of all tools should be carried out and no tool should be used which is damaged in any way or not running freely.

Weekly maintenance of tools should include a check on the condition of the cabling, cleaning out of swarf and dirt round the motor, etc., a check on the gears and the brushes and the condition of all accessories.

Test panels can be obtained to carry out simply a test of earthing continuity, insulation to earth and between conductors and the running current of the tool. Some tool makers can supply schedules of fault symptoms and their probable causes on request.

Considering some of the tools in more detail, by far the more versatile is the electric circular saw which is available in sizes from 6in to 12in diameter and adjustable for bevel cuts. Special blades can be obtained for cutting all the various materials encountered in building work. Chain saws are suitable for cutting baulks of timber up to 12in square and can be used for site clearing of small trees, trimming trench timbers, etc.

Electric drills range from lightweight ¼in models to 1¼in heavy duty models and a range of accessories enables these machines to be used for grinding, polishing, wire brushing and sanding. Where overhead work on steel beams or stanchions occurs a clamping device can be obtained to attach the machines to the steelwork and bench drill stands convert all types into efficient workshop drills.

Orbital disc and belt sanders are available with a variety of scratching, abrasive, or polishing materials. Belt sanders can have dust bags acting on the vacuum cleaner principal attached.

Electric hammers have a wide range of accessories available enabling them to be used for chasing and drilling in brickwork or concrete, the de-scaling of boilers, vibrating concrete, riveting, etc. Larger models are available suitable for demolition work, ramming, etc., and can reduce labour costs by 50-80 per cent.

Portable chain mortisers can be used on the site or in the workshop and are adaptable to vertical or horizontal working. They can be clamped in position as required and in addition to the mortises of ordinary framing, mortises for locks, and pin hinge slots can be cut.

In conclusion, it should be said that the tools referred to are by no means all that are on the market for the building industry. No mention has been made of the wide variety of flexible drive tools. It is hoped, however, that sufficient has been said to leave no doubt that electricity can serve the builder well and that these tools can speed his work.

News from Australia

FROM A CORRESPONDENT

THE Electricity Authority of New South Wales is to launch a campaign to reduce the number of deaths from electrical appliances. Twenty-one persons were electrocuted in N.S.W. in the first three months of the year. The chairman of the Authority, Mr. V. J. F. Brain, announced the campaign at the annual conference of the electricity section of the Local Government Association of New South Wales. He said the death rate from electrical accidents was increasing. In 1955 there had been 39 deaths, compared with an average of 27 over the previous five years. Investigations indicated that most deaths were caused by misuse of appliances, incorrect extensions and neglect.

Mr. Brain also stated that the Authority had begun a State-wide survey of the quality of electricity supplies in preparation for television. Overseas experience, he said, had shown that television viewers were far more critical of the quality of reception than were radio listeners. He urged all distributing authorities to make a "methodical examination" of their service to consumers. The Authority would concentrate at first on that part of the metropolitan area which came within the range of the television transmitting stations. The estimated annual expenditure required for the expansion of power services was £13 million, but councils were likely to secure only about £8 million, so that the distribution industry was some £5 million per annum short of the capital funds required for proper expansion of its assets, he said. The gross retail revenue of electricity supply in N.S.W. was about £60 million a year and an all-round increase of 8 per cent in electricity charges would be necessary if the prospective deficiency of capital funds in the present year were to be made good from revenue.

The Electric Light and Power Corporation, Ltd., Sydney, has been granted an injunction restraining the Electricity Commission of New South Wales from taking over its assets on the proclaimed date.

Australian manufacturers of welding equipment and accessories are satisfied that there is fair business for them in Eastern markets. Mr. W. I. Miskoe, managing director of the Lincoln Electric Co. (Australia) Pty., Ltd., stated recently that the company exported 30 per cent of its total production. Management in Australia had much to learn about how to get more efficient production, he said. The country had plenty of cheap raw materials, especially steel, and labour costs were considerably lower than in the United States, yet it was said that they could not compete. If freight rates were not so high, Australia would be the best place in the world to handle the Eastern business. Mr. S. W. Stock, a director of the International General Electric Co., however, thought that while Australia might find an outlet for light household appliances in the present Asiatic markets, it would be difficult to compete there in the heavier electrical goods. He did not consider that there would be any great expansion in the Far East markets until costs of production were lowered.

In general there is sufficient electricity generating capacity in Australia this winter to meet all peak loads, but only in one State, Western Australia, is there an adequate margin of capacity over demand. The rate of increase of demand is some 10 per cent per annum.

Contractors at the Hume Weir in New South Wales have installed two large steel tunnels to divert water for a £3 million electricity project. The first of the two 25,000 kW turbines should be installed by November next and the second by the middle of 1957.

The TI power station of the Snowy Mountains scheme, due to come into operation in 1958-59, will be constructed 1,200ft below the natural surface of the right bank of the Tumut River. It will be 105ft high, 305ft long and 59ft wide, with a connecting tunnel leading to a transformer hall, which will be 127ft long and 55ft wide. Within the machine hall of the station a four-storey reinforced concrete control building will be constructed. A lift will work in a vertical shaft 10ft in diameter and 1,200ft deep. There will be a tunnel with a 1 in 8 gradient for vehicular access. The control building will have a visitors' lounge. Work on this project was started in 1954. The total installed capacity of the station will be 320,000 kW.

Shaded-Pole and Reluctance-Start Motors

Their Characteristics and Applications

By "ROTOR"

IN order that a single-phase induction motor shall be self-starting when switched on, some sort of a revolving magnetic flux must be produced by the current in the stator windings. This is achieved by causing the magnetic flux in different parts of each pole face to reach peak value at different instants in sequence. In some very small motors the shaded-pole principle is employed for this purpose.

Fig. 1 shows the essential parts of a small disc-type eddy-current motor in which this method is used; such a motor may be used on a low-power drive such as a clock, integrating meter or a gramophone. The laminated stator has a portion of each pole face encircled by a copper shading band, which acts as the short-circuited secondary winding of a transformer of which the stator coil is the primary.

The vector Φ_2 in Fig. 2 refers to the flux encircled by the shading band, whilst Φ_1 refers to the flux in the plain portion of the pole face. These are two component fluxes of the total flux Φ_M produced by the coil current I_o when the disc is absent. The flux Φ_M lags by a quarter of a cycle behind the e.m.f. E_p which is thus self-induced in the primary coil on the stator. The e.m.f. induced in the shading band by the flux Φ_2 will lag behind this flux by a quarter of a cycle; neglecting the reactance of the shading ring, the current I_s induced in the shading ring will also lag behind Φ_2 by a quarter of a cycle. The primary coil current I_o thus has the component $-I'_s$ required to overcome the magnetomotive force due to I_s, and the component I_2 which produces Φ_2. In this way the phase angle α is produced between the two component fluxes at the pole face. Iron losses and other minor effects have been ignored in Fig. 2.

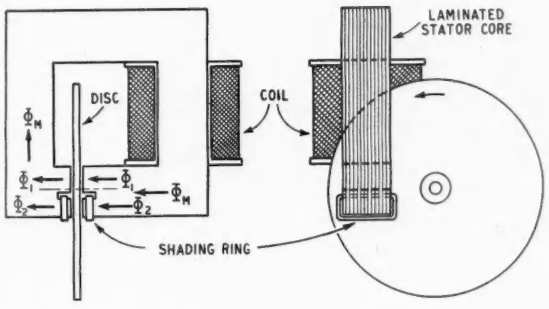


Fig. 1.—Arrangement of a disc-type shaded-pole motor

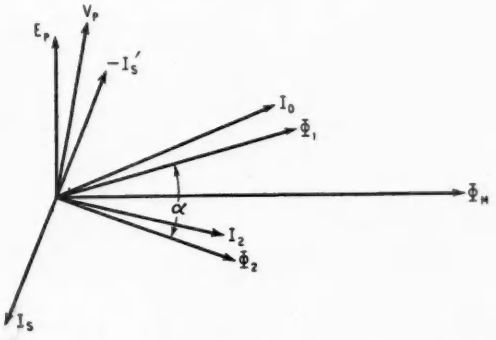


Fig. 2.—Flux vector diagram of a disc-type shaded-pole motor

Production of Motor Torque

The component fluxes Φ_1 and Φ_2 induce the e.m.f.s E_1 and E_2 in the disc, the e.m.f.s lagging behind the fluxes by a quarter of a cycle, as shown in Fig. 3b. The e.m.f.s produce in the disc the eddy currents i_1 and i_2, as indicated in Figs. 3a and 3b. The inductance of the eddy-current paths is responsible for the eddy currents lagging behind the e.m.f.s by the small angle β, whilst the reaction between the eddy currents and fluxes creates a torque on the disc. The stator current I_1 now includes a component $-i'$ to balance the eddy currents, as well as the component I_o which produces the magnetic flux and the current in the shading ring. Thus the power factor of the motor is $\cos\theta$, whilst the power input is equal to $V_p \times I_1 \times \cos\theta$, when the rotor is at rest.

Whilst the rotor is at rest, the torque due to the current i_1 reacting with the flux Φ_2 is proportional to the product of these two quantities and to the cosine of the phase angle between them. The total torque is equal to $K[i_1\,\Phi_2\cos(90+\beta-\alpha) - i_2\,\Phi_1\cos(90+\beta+\alpha)]$, where K is a constant. Thus the torque is equal to $K[i_1\,\Phi_2\sin(\alpha-\beta) + i_2\,\Phi_1\sin(\alpha+\beta)]$. Since i_1 is practically proportional to E_1, which is proportional to $\frac{\Phi_1 f}{Z}$, where f is the frequency and Z the impedance of the path of the eddy currents, the torque equation can be written $T = \frac{K_1 f \Phi_1 \Phi_2}{Z}[\sin(\alpha-\beta) + \sin(\alpha+\beta)]$. This is equal to $T = \frac{2K_1 f \Phi_1 \Phi_2}{Z}\sin\alpha\cos\beta$, where K_1 is another constant.

Factors Controlling Speed and Torque

The above equation applies when the disc is stalled. When the disc rotates e.m.f.s are generated due to the disc cutting the fluxes but, as the disc is normally controlled to run at a low speed, these dynamic e.m.f.s are usually so small that they may be practically ignored. The resistance of the disc depends on the disc material, which is usually copper or aluminium; on the thickness of the disc, which is usually 16 to 24 s.w.g.; and on the radius, which is normally about 1·5 to 3 inches. Whilst the torque is thus approximately proportional to the thickness of the disc, the wider air gap necessary to accommodate a thicker disc will increase the number of amp-turns required to produce the flux. For good practical results the centre

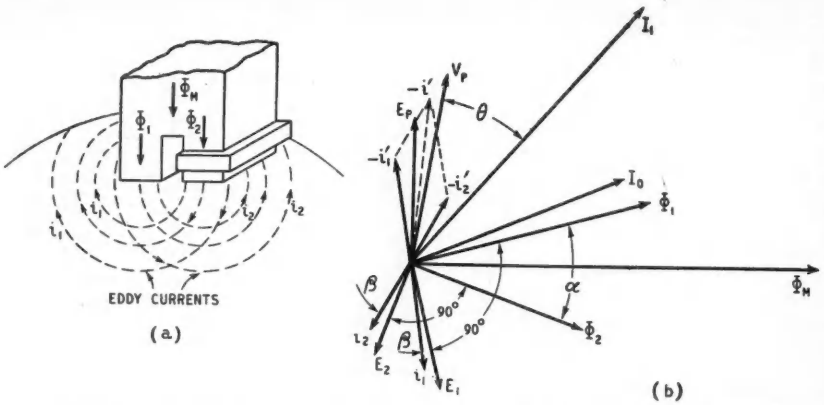


Fig. 3.—Vector diagram showing eddy currents in the disc of an eddy-current motor

of the poles should be about 0·7 of the disc radius, and the length of the pole should be approximately a quarter of the radius of the disc. The number of turns on the stator winding for use on a given supply voltage V may be taken as equal to $\frac{V \times 10^8}{4{\cdot}44 \times f \times \Phi_M}$, where Φ_M is the peak value of the total flux.

The speed of this type of motor can be increased within limits by moving the poles nearer to the centre of the disc, although this reduces the torque. Another way of controlling the speed is by using a motor in which one of the main poles can be turned through a small angle so that the shaded portion of one pole face is not exactly opposite the shaded portion of the other pole face.

Larger types of shaded-pole motors have a normal squirrel-cage rotor, with a laminated stator. Fig. 4 shows the arrangement of a four-pole motor having salient (shaped) poles. The torque exerted on the rotor at standstill, or when turning slowly, is approximately proportional to $\Phi_1 \Phi_2 \sin \alpha$, where Φ_1 and Φ_2 are the fluxes in the unshaded and the shaded portions of the pole face respectively, and α is the phase angle between these component fluxes. Φ_1 and Φ_2 are proportional to Φ_M, so that the stalled torque is proportional to Φ^2_M (approximately). Providing the magnetic core is not operated at such a high flux density that the cores are almost saturated, the flux will be practically proportional to the amp-turns. The efficiency of such a motor is very low, and the full-load current little greater than the no-load current, as shown in Fig. 10. Air gap flux densities in these motors may vary from about 1,600 to 6,000 lines per square cm.

Shaded-pole motors are seldom made in sizes over about $\frac{1}{40}$ h.p., and the shading band may encircle 30 to 50 per cent of the pole. It is preferable for the shading bands to be continuous. However, with the motor shown in Fig. 4, it is necessary to use a jointed shading band, in which case the joint should be made with silver soldering. Figs. 5, 6, and 7 show some other arrangements. Some

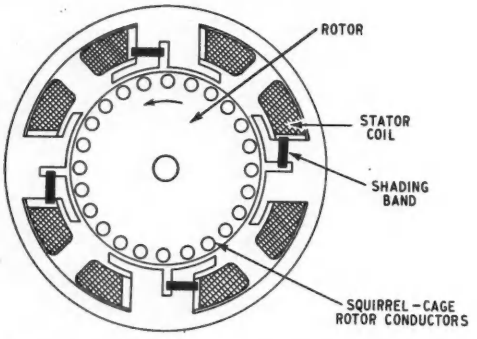


Fig. 4.—Arrangement of a simple shaded-pole motor

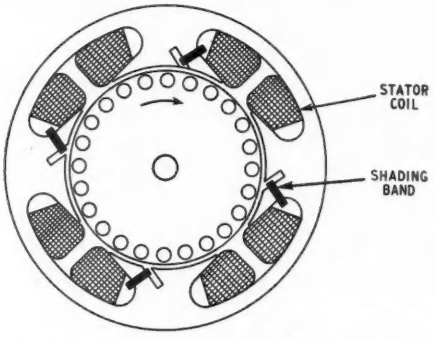


Fig. 5.—Another type of four-pole shaded-pole motor

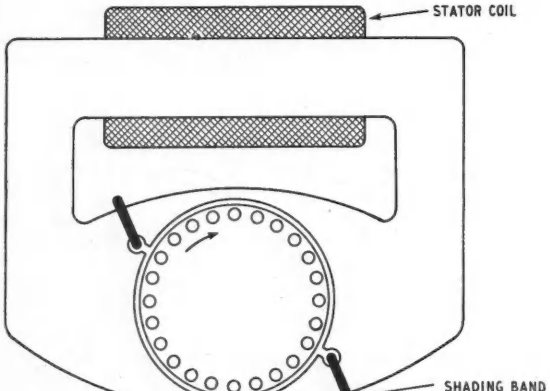


Fig. 6.—One type of two-pole shaded-pole motor with a single-stator coil

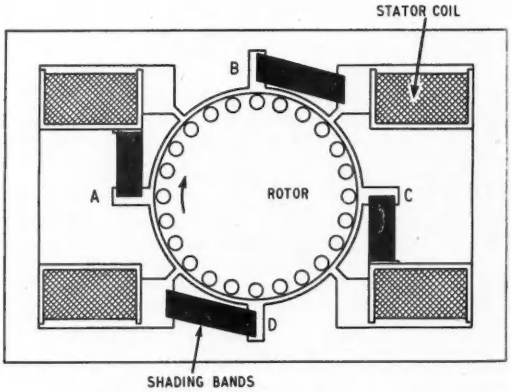


Fig. 7.—Shaded-pole motor with a rectangular stator

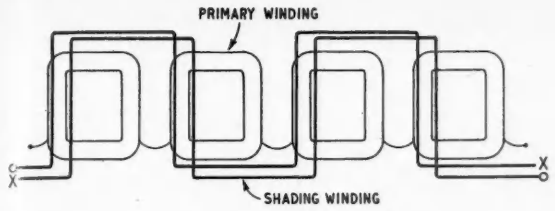


Fig. 8.—Arrangement of a four-pole motor with distributed shading winding

shaded-pole motors are of the consequent-pole type, having a laminated slotted stator with a distributed stator winding, and a uniform radial air gap between the stator and rotor. As indicated in Fig. 8, the shading winding of such a motor may consist of two or three turns of insulated wire per pole, which may be wave wound. The ends of the shading winding may be joined together, or may be brought out to terminals, although the latter arrangement is unusual. The shading winding is required to create a rotating magnetic field for starting. When the motor is running the magnetic field produced by the induced current in the squirrel-cage rotor is displaced from the magnetic axis of the stator and, since the peak fluxes occur at different instants, a revolving flux is then created. Consequently if the ends of the shading winding are brought out to terminals a special starter is sometimes provided by means of which the shading winding is momentarily short circuited during starting only.

The synchronous speed of a squirrel-cage shaded-pole motor in r.p.m. is equal to $\frac{60 \times f}{\text{number of pole pairs}}$, whilst the full-load speed may be less than 90 per cent of synchronous speed. Thus a low-speed motor, as may be required for driving a large low-speed fan or for direct driving of a gramophone turntable, will have a large number of poles. The arrangement of such a motor may be the reverse to normal as indicated in Fig. 9. The outer casing of this motor is the revolving element and has a squirrel-cage winding, whilst the inner portion is the wound stator. The machine indicated in Fig. 9 has a winding on alternate poles, which are joined by iron leakage strips. Such leakage strips are fitted on many salient-pole shaded-pole motors of normal design.

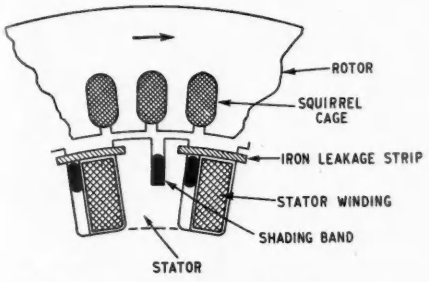


Fig. 9.—Section of a multi-pole shaded-pole motor with external rotor

Fig. 10 shows the characteristics of one shaded-pole motor. The efficiency is seldom more than about 15 per cent on full load, whilst the power factor is reasonably high. Fig. 11 shows the starting torque of a typical motor. In general the starting torque of a shaded-pole motor may be about 30 to 80 per cent of full-load torque and normally a higher starting torque is obtainable with a shaded-pole area equal to about half the total pole area, although this gives a lower running efficiency than with a smaller shaded area. One type of motor has two or even three shading coils, each covering a larger area of pole face. Decreased resistance of shading bands improves the starting torque at the expense of running efficiency. A motor which has been designed to drive a fan which is not subject to overload may have a pull-out torque no more than about 125 per cent of full-load torque.

Since the current input to most shaded-pole motors varies little from full-load torque to standstill these motors can be stalled for long periods without damage. This characteristic, and the low cost of a shaded-pole motor, makes it a useful machine for operating valves, etc. Variation of voltage does not cause much variation of speed. Since the no-load current is high it is possible to design such a motor with a single stator winding which is suitable for 200 to 250 V, and for frequencies of 50 to 60 c/s. If the stator windings are in two parts it is then possible to connect the sections in series for use on 200–250 V, or in parallel for use on 100–130 V.

Reversal and Speed Control

The standard design of shaded-pole motor cannot be reversed by switching operations. Since the rotor always moves towards the shaded portion of each pole face from the other portion, the motor may be reversed by the mechanical operation of reversing the stator bodily in the end shields, or by reversing the stator and end shields on the bearings or shaft. Specially-wound shaded-pole motors can, however, be obtained which can be reversed by means of a switch. The motor shown in Fig. 12a has two shading windings of insulated conductors, one for either direction of rotation. The direction of rotation depends on which shading winding is short circuited by the switch, as

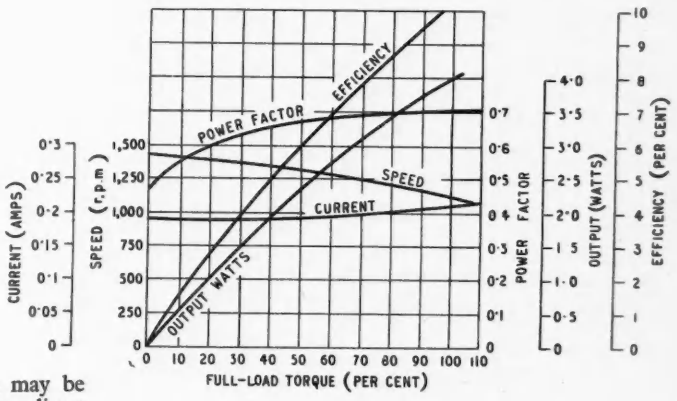


Fig. 10.—Characteristics of a small shaded-pole motor

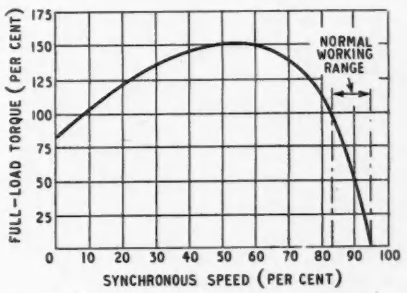


Fig. 11.—Starting torque of a typical motor

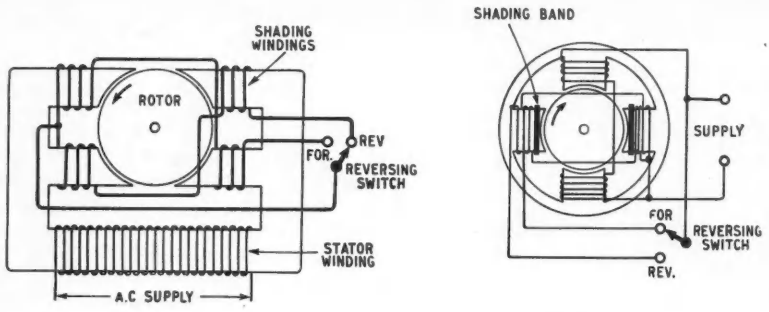


Fig. 12.—Arrangement of two types of reversible shaded-pole motor

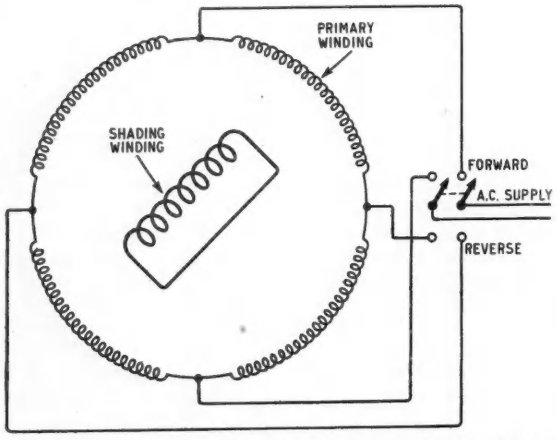


Fig. 13.—Schematic diagram of a four-wire reversible shaded-pole motor with distributed primary winding

indicated. Fig. 12b shows the arrangement and connections of a two-pole motor which has insulated coils on auxiliary shaded poles. A reversing switch is used so that an auxiliary pole can be used as the shaded pole for either one of the main poles. Fig. 13 shows the connections of a motor having a distributed winding, together with a shading-pole winding which is internally shortc-ircuited. The main winding is tapped at points which are 90 electrical degrees apart, at points which are displaced 45 electrical degrees from the centre of the shading coils. The whole of the stator winding is used for either direction of rotation, as indicated.

The speed of a squirrel-cage shaded-pole motor can be reduced by means of a resistor or choke coil connected in series with the primary winding on the stator. However, this method is only suitable for a drive which requires a reduced torque at reduced speed, such as a fan. The type of motor shown in Fig. 7 may, however, be run on either of two speeds by alteration of the connections. The two stator coils may be connected so that the poles A and C have the same magnetic polarity, with consequent poles of opposite polarity at B and D, so that the motor runs as a four-pole machine. Alternatively the two stator coils may be connected so that the poles A and C have opposite polarity, the flux then by-passing the poles B and D, so that the motor runs at a higher speed as a two-pole machine.

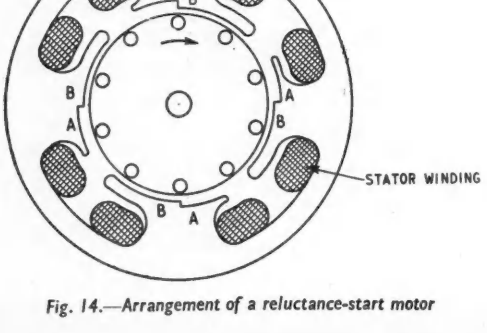


Fig. 14.—Arrangement of a reluctance-start motor

Reluctance-Start Motors

Fig. 14 shows the arrangement of a reluctance-start squirrel-cage motor. In this machine the lag of magnetic flux in the portions B of the pole faces is obtained by providing a reduced air gap length under these portions. The portions B of the poles will have the least reluctance so that most of the magnetic flux will pass from the stator to the rotor across these portions of the air gap. However, the wider air gap A has less hysteresis and as a result the flux across the wider gap reaches its peak value before that across the shorter gap. Reaction between the magnetic fluxes and the induced rotor currents causes the rotor to be dragged round in the direction from the longer to the shorter air gaps.

In order to change the rated voltage of a shaded-pole or a reluctance-start motor the primary coils should be rewound with a number of turns proportional to the voltage. With such a change the cross-sectional area of the wire should be changed in inverse ratio to the voltage. Low starting torque may be due to lack of lubricant, reduced voltage, faulty joints in a squirrel-cage rotor, or in the shading bands of a shaded-pole motor, or short circuit or earth fault on the primary winding.

The starting torque may depend slightly on the rotor position. If the stator slots are parallel to the shaft cogging may occur, in which the motor may refuse to start with the rotor in certain positions. Cogging is particularly liable in such a motor if the machine has a particularly short air gap.

BOOKS RECEIVED

Electricity, Magnetism and Atomic Physics. Vol. 1—Electricity and Magnetism. By J. H. Fewkes, Ph.D., F.Inst.P., and John Yarwood, M.Sc., F.Inst.P. Pp. 768; figs. University Tutorial Press, Ltd., Clifton House, Euston Road, London, N.W.1. Price 36s.

A Handbook on Belt Conveyor Design. Compiled by the Technical Staff, Materials Handling Department, in association with Hewitt-Robins, Inc., New York. Pp. 148; figs. General Electric Co., Ltd., Fraser & Chalmers Engineering Works, Erith, Kent. Price 30s.

Color Television Receiver Practices. Edited by Charles E. Dean. Pp. 200; figs. Chapman & Hall, 37, Essex Street, London, W.C.2. Price 36s.

Mechanical Design for Electronic Engineers. By R. H. Garner, B.Sc.(Eng.), A.M.I.E.E., A.M.I.Mech.E., A.F.R.Ae.S., A.M.I.P.E., A.M.Brit.I.R.E. Pp. 223; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 25s.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 25th July from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

9273. Bertele, H. C., and Adam, H.—High tension gas or vapour filled rectifier valves. 21st July, 1952. (753654.)

28030. Philco Corporation.—Cathode-ray tubes having beam position indicating means. 29th November, 1951. (753442.) 29746. Cathode-ray tube apparatus. 19th December, 1951. (753444.)

1952

688. Standard Telephones & Cables, Ltd.—Mounting arrangements for wires and components of electrical circuits. 2nd January, 1953. (753445.)

3254. Philips Electrical Industries, Ltd.—Magnetic electron lenses. 7th February, 1952. (753562.)

5781. Philco Corporation. — Electrical signalling systems. 5th March, 1952. (753447.)

8143. Philco Corporation.—Cathode-ray tube systems. 26th March, 1952. (753448.)

13315. Raytheon Manufacturing Co.—Electron discharge devices of the magnetron type. 26th May, 1952. (753302.)

18356. Caillot, F. H., Caillot, J. R., and Caillot, J. P.—Lighting fittings. 21st July, 1952. (753450.)

19395. Philco Corporation.—Cathode-ray tube systems. 31st July, 1952. (753451.) 19512. Cathode-ray tubes. 1st August, 1952. (753452.)

22542. British Thomson-Houston Co., Ltd.—Electric discharge lamps. 8th September, 1953. (753453.)

31169. Standard Telephones & Cables, Ltd.—Mounting arrangements for electric circuit chassis. 4th December, 1953. (753457.)

1953

1028. English Electric Co., Ltd.—Dual fuel engines. 7th April, 1955. (753308.)

8138. Boart Products, South Africa, Ltd.—Electric cutting and shaping. 24th March, 1953. (753466.)

10020. Southern United Telephone Cables, Ltd.—Arrangement for actuating electric relays in sequence. 13th April, 1954. (753471.)

10474. Marconi's Wireless Telegraph Co., Ltd.—Colour television systems. 17th June, 1954. (753313.)

12771. New Era Industries (Tottenham), Ltd., and Pickess, A. R.—Fluorescent lighting. 7th May, 1954. (753477.)

16751.—Edison Swan Electric Co., Ltd.—Incandescent electric lamps. 27th May, 1954. (753484.)

18108. British Thomson-Houston Co., Ltd.—Circuits utilising saturable reactors. 30th June, 1954. (753321.)

19173. Standard Telephones & Cables, Ltd.—Electrical couplings to semi-conductor elements. 2nd July, 1954. (753488.)

21598. Varian Associates.—Electrical circuits. 5th August, 1953. (753495.)

22762 and 22877. General Electric Co.—Dynamic balancing apparatus. 18th and 19th August, 1953. (753579/80.)

24305. General Electric Co., Ltd., and Bowyer, A. W.—Electromagnetic torque producing devices such, for example, as polarised relays. 17th August, 1954. (753327.)

24524. Metropolitan-Vickers Electrical Co., Ltd.—Electrical transformer tap-changing equipment. 21st September, 1954. (753581.)

26474. General Electric Co., Ltd.—Electron gun assemblies for electric discharge devices. 27th September, 1954. (753507.)

26599. Alfa-Laval Co., Ltd., and Corderoy, N.—Electromagnetically controlled milking machines. 22nd September, 1954. (753508.)

27543. Philips Electrical Industries, Ltd.—Radio receivers for use in television. 7th October, 1953. (753509.)

28120. Westinghouse Electric International Co.—Copper cyanide electro-plating processes and electrolytes. 13th October, 1953. (753586.)

29789. Western Electric Co., Inc.—Semiconductor signal translating device and circuits. 28th October, 1953. (753514.)

30540. General Electric Co., Ltd., and Imin, R. C.—Thermionic valve circuits of the kind supplying electric current pulses having constant peak amplitude. 29th October, 1954. (753662.)

30753. Sperry Corporation.—Engine analysers comprising cathode-ray tubes. 6th November, 1953. (753338.)

30941. Murad, W. H.—Electric motors. 9th February, 1955. (753589.)

32037. General Electric Co., Ltd., Hopkins, B. J., and Thomason, J. A.—Electromagnetic waveguide shutter devices. 10th November, 1954. (753524.)

32608. Siemens-Shuckertwerke Akt.-Ges.—Dry rectifier assemblies. 24th November, 1953. (753527.)

34817. Pott, L.—Electrical thermal control fuses. 15th December, 1953. (753353.)

35566. Edison Swan Electric Co., Ltd.—Electron discharge devices. 22nd December, 1954. (753536.)

36166. Fernseh Ges.—Television camera apparatus. 30th December, 1953. (753601.)

1954

192. British Insulated Callender's Cables, Ltd.—Electric cables for high working voltages. 3rd January, 1955. (753604.)

890. Metropolitan-Vickers Electrical Co., Ltd.—Saturable core reactance devices. 12th January, 1955. (753356.)

1005. Standard Telephones & Cables, Ltd.—Electric code translators. 7th January, 1955. (753357.)

1006. Standard Telephones & Cables, Ltd.—Interconnection of circuit components and terminals. 7th January, 1955. (753605.)

1631. Metropolitan-Vickers Electrical Co., Ltd.—Dynamo-electric machines. 11th November, 1954. (753359.)

3442. Western Electric Co., Inc.—Broad frequency band transmission systems. 5th February, 1954. (753546.)

3797. General Electric Co., Ltd., and Parton, K. C.—Magnetic amplifier arrangements. 24th January, 1955. (753363.)

3928. General Electric Co.—Laminated asbestos materials. 10th February, 1954. (753610.)

4816. Hetherington, Inc.—Snap-action electric switch. 18th February, 1954. (753678.)

5302. Steatite Research Corporation.—Ferrite elements for microwave apparatus using the Faraday effect. 23rd February, 1954. (753368.)

6540. Moser-Glaser & Co. Akt.-Ges., and Reyrolle & Co., Ltd., A.—Metalclad h.v. switchgear. 5th March, 1954. (753375.)

6743. Reyrolle & Co., Ltd., A.—H.v. circuit-breakers. 3rd March, 1955. (753376.)

7448. Clevite Corporation.—Binding responsive electro-mechanical transducer device. 15th March, 1954. (753617.) 7449. Forming electro-mechanically sensitive ceramic bodies. 15th March, 1954. (753618.) 7450. Fabrication of dielectric elements, particularly electro-mechanical transducer elements. 15th March, 1954. (753619.)

7718. Ebauches Soc. Anon.—Electronic circuit adapted to assume a number of stable conditions. 17th March, 1954. (753687.)

7973. Compagnie Générale de Télégraphie sans Fil.—Pulse modulating circuits for travelling-wave tubes of the crossed-field type. 18th March, 1954. (753688.)

8460. Teletype Corporation.—Distributor utilising transistors. 23rd March, 1954. (753689.)

8522. Decca Record Co., Ltd.—Electrical stepping mechanisms. 17th January, 1955. (753690.)

9187. Reyrolle & Co., Ltd., A.—Electrical switchgear. 28th June, 1955. (753379.)

11533. Philips Electrical Industries, Ltd.—Cathode-ray tubes of the kind comprising a cone and a glass window. 21st April, 1954. (753696.)

13543. Sperry Corporation.—Test apparatus for electrical systems. 10th May, 1954. (753392.)

13930. Siemens-Schuckertwerke Akt.-Ges.—Arrangements for exciting synchronous generators. 12th May, 1954. (753400.)

14038. Philco Corporation.—Cathode-ray tubes. 1st August, 1952. (753551.)

14754. Telefonaktiebolaget L. M. Ericsson.—Arrangements for signalling or impulsing in multiplex pulse communication systems. 19th May, 1954. (753394.)

15061. Siemens-Schuckertwerke Akt.-Ges.—Electric remote control arrangements. 21st May, 1954. (753629.)

15296. United-Carr Fastener Corporation.—Electrical plug and socket connectors. 24th May, 1954. (753395.)

15596. Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.—Devices for measuring the variations of a magnetic field. 26th May, 1954. (753707.)

15737. Siemens-Schuckertwerke Akt.-Ges.—Stage switchboards for electric stage lighting installations. 27th May, 1954. (753396.)

16063. Philips Electrical Industries, Ltd.—Rhythmical telegraphy systems. 31st May, 1954. (753397.)

16124. United-Carr Fastener Corporation.—Electrical switches. 31st May, 1954. (753398.)

17267. Metropolitan-Vickers Electrical Co., Ltd.—Cooling arrangements for the windings of dynamo-electric machines. 11th June, 1954. (753401.)

17575. Welding Research, Inc.—Electrical circuits for timing a sequence of operations. 15th June, 1954. (753403.)

17879. Siemens & Halske Akt.-Ges.—Means for potential selection in telecommunications circuits. 17th June, 1954. (753406.)

18574. Globe-Union, Inc.—Printed electrical circuit. 24th June, 1954. (753632.)

18970. Westinghouse Electric International Co.—Turbines, particularly gas turbines. 29th June, 1954. (753633.)

22699. Telefonaktiebolaget L. M. Ericsson.—Connecting means for electric power transmission within a signal transmission installation. 4th August, 1954. (753415.)

24036. Naamlooze Vennootschap Coq.—H.v. electric switching apparatus. 18th August, 1954. (753639.)

24311. General Electric Co.—Temperature control system for electrical heating elements. 20th August, 1954. (753420.)

25589. Standard Telephones & Cables, Ltd.—Arrangement for suppressing the d.c. component in television signals. 3rd September, 1954. (753424.)

31661. Philco Corporation.—Cathode-ray tubes and particularly screen structures therefor. 29th November, 1951. (753555.)

33058. Pestarini, J. M.—Electric power systems. 15th November, 1954. (753556.)

35047. Standard Telephones & Cables, Ltd.—Electric pulse modulating and demodulating circuits. 3rd December, 1954. (753645.)

36753. Philips Electrical Industries, Ltd.—Method of manufacturing laminations for a ferromagnetic core. 20th December, 1954. (753651.)

36972. Southern United Telephone Cables, Ltd.—Testing of the insulation of electric conductors. 26th May, 1953. (753557.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia. — 2nd August. Queensland Government Railways. Time indicating, time recording and signalling systems. (E.S.B. 17435/56. Ten/20207.)*

16th August. Commonwealth of Australia. Switchboard cable. (E.S.B. 17066/56. Ten/20145.)* 21st August. Switch maintenance parts. (E.S.B. 17065/56. Ten/20176.)*

Belfast.—10th August. Electricity Department. V.h.f. fixed and mobile radio telephone communication equipments. (See this issue.)

Durham.—25th July. County Council. Renewing electrical installation in Bishop Auckland Girls' Grammar School. (See this issue.)

Egypt.—15th August. Cairo Electricity and Gas Administration. 100 metalclad switchgear units. (E.S.B. 17375/56. Ten/20185.)*

Formosa.—10th August. Central Trust of China, Purchasing Department. Five sets of power circuit-breakers. (E.S.B. 17711/56. I.C.A. Ten/20231.)*

India.—7th August. Government of Saurashtra. 140 100-2,000 kVA transformers. (E.S.B. 17092/56. Ten/20163.)*

1st August. Government of Mysore. Two 3,000 kVA transformers. (E.S.B. 17499/56. Ten/20233.)*

4th September. Director General of Supplies and Disposals. 132 kV substation equipment including transformers, circuit-breakers, lightning arrestors, switchgear, etc. (E.S.B. 17494/56. Ten/20226.)*

1st October. Rihand Hydel Circle, Electricity Department, George Town, Allahabad. 132 kV double circuit lines. (E.S.B. 17615/56. Ten/20238.)*

Kinghorn.—15th August. Burgh Council. Street lighting equipment. (See this issue.)

Manchester.—20th August. Corporation. Electric motors, switchgear and ancillary equipment for two penstocks. (See this issue.)

New Zealand.—11th September. General Post Office. 4,000 potentiometers and 4,350 resistors. (E.S.B. 17245/56. Ten/20177.)*

Northern Ireland.—6th August. Antrim County Education Committee. Heating and electrical installations in the new intermediate school, Ballymena. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Pakistan.—13th August. Posts and Telegraphs Department. Cable sleeves. (E.S.B. 17645/56. Ten/20252.)*

South Africa.—1st August. Stores Department, South African Railways. Cable. (E.S.B. 16905/56. Ten/20113.)* 15th August. Telegraph line material. (E.S.B. 16904/56. Ten/20112.)*

17th August. City of Durban Electricity Department. 250 MVA switchboard. (E.S.B. 17025/56. Ten/20131.)*

United States.—26th July. Bureau of Reclamation. Light duty unit substation, battery charging equipment and d.c. distribution board. (E.S.B. 16899/56. Ten/20214.)*

Uruguay.—23rd August. Administracion General de las Usinas Electricas y los Telefonos del Estado. 40 400 kVA transformers. (E.S.B. 17717/56. Ten/20236.)*

West Hartlepool.—13th August. Corporation. Electrical installation in the infants' department of the new Owton Manor County Primary School. Borough architect (A. G. Sinclair), Municipal Buildings, West Hartlepool.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Scunthorpe.—Corporation. Recommended. Electrical installations in 50 dwellings at the Riddings estate (£1,542).—H. Holl.

Sheffield.—Corporation. Electrical installation work for Stage II of the College of Technology, Pond Street (£9,691).—Yorkshire Electricity Board.

South Shields.—Corporation. Electrical installation in new Biddick Hall School (£2,985).—J. Robinson (Newcastle).

Walthamstow.—Corporation. Electrical installations in houses at The Drive (£2,189).—Hancox & Co. (Leyton).

Warrington.—Corporation. Electrical installations at Orford Secondary Modern School (£19,338).—H. Bibby & Co.

York.—City Council. Rewiring work at Archbishop Holgate's Grammar School (£1,050).—H. Todd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aycliffe.—Houses (121); Aycliffe Development Corporation, Newton Aycliffe.

Bakewell.—Engineering factory at rear of the Beeches, and adaptations for offices, etc.; Bakewell Precision Grinding Co., Buxton Road, Bakewell, Derbyshire.

Beckenham.—Out-patients' department for General Hospital; South East Metropolitan Regional Hospital Board, 9, Hallam Street, London, W.1.

Grammar school for Kent E.C.; G. E. Wallis & Sons, Ltd., builders, 231, Strand, London, W.C.2.

Belfast.—Flats (36) at Lisburn Road and St. Paul's Street; City Council.

Birmingham.—Dwellings (108) on the Moat site, Hawkesley Farm, Northfield; A. G. Sheppard Fidler, city architect, Civic Centre.

Brigg.—Scheme for open and covered markets, shops, offices and housing accommodation on 14A site; U.D.C. architect, Brigg, Lincs.

Bromley.—School at Bromley Common (£247,000); S. H. Loweth, county architect, Springfield, Maidstone.

Colchester.—Houses (200), Pretty Gate estate; borough architect.

Coventry.—Swimming baths containing main pool, small pool, teaching pool, games deck, restaurant and slipper baths (£878,000); A. G. Ling, city architect, Bull Yard, off Warwick Row.

Croydon.—Phase III of Technical College and College of Art; Robert Atkinson & Partners, architects, 13, Manchester Square, London, W.1.

Cumberland.—Secondary school at Cleator Moor, and five rural police stations and 18 police houses on various sites; county architect, 15, Portland Square, Carlisle.

Dartford. — Works extensions; Vitretex (England), Ltd., Princes Road.

Derby.—Derby and Derbyshire College of Technology, Kedleston Road (£237,563), first instalment; borough architect, Council House, Corporation Street.

Durham.—Fire station at Spennymoor; county architect, South Street, Durham.

Felling (Co. Durham).—Houses (152) on the Leam Lane estate for U.D.C.; R. Morton, housing officer.

Gosforth.—Houses (20) and bungalows (36) on the Regent Farm estate; M. J. Liddell and Son, Ltd., builders, 36, Great North Road, Newcastle-on-Tyne.

Great Yarmouth.—Houses in George Street (64) and on Magdalen College estate (94); borough surveyor, 15, Regent Street.

Hamilton.—Houses (80), Edward Street and Burnblea Street site; burgh architect, Cadzow Street.

Hartlepool.—Church of the Holy Trinity, Davison Drive; G. E. Charlewood, architect, 14, Neville Street, Newcastle-on-Tyne.

Ilford.—Five-storey laboratory, Roden Street; Ilford, Ltd., Head Office, Ilford.

Factory and offices, High Road; Witty and Wyatt, Ltd., Witwy Works, Stanley Road, Ilford.

Leamington Spa.—Council chamber with administrative offices on site adjoining Council offices in Warwick New Road, for Warwick R.D.C.; Quick and Lee, architects, 11, Waterloo Place.

Leicester.—Houses (752) and shops proposed in the Wharf Street re-development area; J. H. Lloyd Owen, city architect, 7, Newarke Street.

Littlehampton.—Shops and offices, Beach Road; Brighton, Worthing & District Property Co., Ltd., 14, Grand Parade, Brighton.

Liverpool.—Rebuilding central library, William Brown Street (£401,769), for T.C.; Tysons (Contractors), Ltd., Dryden Street, Liverpool, 5.

London.—Flats (48), Winstanley Road, Battersea; borough surveyor.

Multi-storey office block, 68/104, Knightsbridge; Taylor Woodrow, Ltd., builders, Adrienne Avenue, Southall.

St. Michael's School, Graham Terrace, Westminster; H. Fairweather & Co., Ltd., builders, Hyde Works, St. James Lane, N.10.

Four-storey offices and warehouse, Borough High Street, Southwark, for Nettlefold & Moser, Ltd.; F. Boreham, Son & Wallace, architects, Victoria House, Southampton Row, W.C.1.

Industrial and office buildings, 13-21, Park Royal Road, Acton; Allnatt (London), Ltd., builders, Chase estate, Park Royal Road, N.W.10.

Maidstone.—Bakery on two-acre site on Park Wood estate, Sutton Road; P. & H. Bakeries, Tonbridge Road.

Manchester.—Langley Primary School, Middleton, and Peel Hall Primary School, Worsley; Cruickshank & Seward, architects, 196, Deansgate.

Mansfield.—Flats (32) and houses (26) on Ladybrook estate (site 5G); A. C. Shepherd, town clerk, Carr Bank.

Middlesbrough.—Church, College Road; T. A. Crawford, architect, 80, Borough Road.

Office block, Marsh Road, for Lionweld, Ltd.; Leslie and Co., Ltd., builders, Woodland Road, Darlington.

Newcastle-on-Tyne. — County secondary schools at Alnwick (£143,412) and Belford (£59,027); county architect, County Hall.

Northern Ireland.—Factory at Bessbrook, Armagh, for Bessbrook Products, Ltd.; Ministry of Commerce, Belfast.

Factory extensions for Down Shoes, Ltd., Newry Road, Banbridge, Co. Down; J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Oxford.—Science block for College of Art, Technology and Commerce; borough architect.

Peterborough.—Houses (48), maisonnettes (32), and shops with flats (6), Paston-Gunthorpe estate; city engineer, Bridge Street.

Poole.—Factory, Broom Road, Alderney; Alderney Construction Co., Ltd., Jacey House, The Lansdowne, Bournemouth.

South Shields.—Office block in the Market Place (£27,000); Tate & Holmes, Ltd., builders, Benwell, Newcastle-on-Tyne.

Tewkesbury.—Houses (59), Canterbury Leys; borough surveyor, Municipal Offices.